recreational uses discussed above. The KOPs were used as standard locations from which to describe existing visual resources at a localized scale, and to assess potential effects that may result from the proposed project. KOPs are described in Table 3.11-1 by viewer group. Note that more than one viewer group may use an area represented by a KOP.

Table 3.11-1: Key Observation Points

Number	Location (Physiographic Zones and estimated Lat/Long)	Analysis Factors	Viewer Sensitivity	Viewer Duration
1	• Kenai • 59°56'4.13"N 151°44'48.51"W • Deep Creek State Recreation Area	Natural gas pipeline shoreline infrastructure	• Foreground, middle ground • Low to moderate visual sensitivity • Focal as the Pipeline follows the scenic Sterling Highway	Intermittent
2	• Kenai • 59°46'40.41"N 151°51'52.06"W • Anchor Point State Recreation Area	Natural gas shoreline infrastructure	• Foreground • Potential for high sensitivity • Visibility: focal; dominant Pipeline and substation • Recommended as a KVA	Intermittent
3	• Kenai • 59°30'50.09"N 153°16'41.31"W Kamishak Bay Augustine Island North	Amakdedori Port facilities; increased shipping traffic	• Immediate foreground, middle ground • High sensitivity • Visibility: focal; co-dominant Augustine Island • Recommended as a linear KVA approach by boat to the KVA	Prolonged
4	• Kenai • 59°13'47.27"N 153°37'27.40"W • Kamishak Bay Augustine Island South	Amakdedori Port facilities; increased shipping traffic	• Immediate foreground, middle ground • High sensitivity • Visibility: focal; co-dominant with background views of the McNeil River Wildlife Refuge, Augustine Island and glacial mountain peaks • Recommended as a linear KVA – approach by boat to the KVA	Prolonged
5	• Kenai • 59°15'35.49"N 154° 8'22.11"W • Nordyke Islands Adjacent to McNeil River State Game Sanctuary (SGS) and State Game Refuge (SGR)	Amakdedori Port facilities; increased shipping traffic	• Foreground and middle ground • Moderate to high sensitivity • Recommended as a linear KVA – approach by boat to the KVA	Prolonged

Table 3.11-1: Key Observation Points

Number	Location (Physiographic Zones and estimated Lat/Long)	Analysis Factors	Viewer Sensitivity	Viewer Duration
6	• Kenai • 59°15'35.49"N 154° 8'22.11"W • McNiel River State Game Refuge	Amakdedori Port facilities; increased shipping traffic	• Immediate foreground • High sensitivity from the shoreline at the mouth of McNeil River • Dominant/focal view • Mouth of McNeil River highly scenic, highly visited area • Recommended as a KVA	Prolonged
7	• Nushagak –Bristol Bay Lowland • 59° 0'57.74"N 156°12'53.24"W • Alagnak Wild River	Mine Site, ferry terminals and icebreaker ferry	• Background • Low sensitivity from the fixed viewpoint along the river • High sensitivity from elevated view point while traveling to the river • Visibility: bare earth; low due to distance and scale of project • Recommended as a KVA due to its status as Wild River	Intermittent
8	• Nushagak – Bristol Bay Lowland • 59°29'51.72"N 155°16'3.57"W • Iliamna Lake South	Mine Site, ferry terminals and icebreaker ferry	• Foreground: ferry terminals and icebreaker ferry • Middle ground: Pipeline and transportation corridor • Background: Mine site operations • Low sensitivity from the fixed viewpoints at the south end of the lake • High sensitivity from elevated view point while traveling to the river • Visibility: bare earth; low due to distance and scale of project • Visibility: focal; co-dominant • Recommended as a KVA	Intermittent
9	• Nushagak – Bristol Bay Lowland • 59°31'56.87"N 154°49'45.94"W • Iliamna Lake North	Mine Site, ferry terminals and icebreaker ferry	• Foreground: ferry terminals and icebreaker ferry • Middle ground: Pipeline and transportation corridor • Background: Mine site operations • Low sensitivity from the fixed viewpoints at the south end of the lake • High sensitivity from elevated viewpoint while traveling to the river • Visibility: bare earth; moderate to high due to proximity, distance and scale of project • Visibility: focal; co-dominant • Recommended as a KVA	Intermittent

Table 3.11-1: Key Observation Points

Number	Location (Physiographic Zones and estimated Lat/Long)	Analysis Factors	Viewer Sensitivity	Viewer Duration
10	• Nushagak – Bristol Bay Lowland • 59°44'5.94"N 154°57'52.55"W Newhalen River	Mine Site, ferry terminals and icebreaker ferry. Transportation Corridor	• Foreground: Mine site operations and the Transportation Corridor • Middle ground: ferry terminal and icebreaker • High sensitivity within the foreground setting • Moderate sensitivity in the middle ground setting • Visibility: bare earth; moderate to high due to proximity, distance and scale of project • Visibility: focal; dominant • Recommended as a KVA	Intermittent
11	• Alaska Range • 59°15'35.49"N 154° 8'22.11"W • Roadhouse Mountain trail overlook	Mine Site, ferry terminals and icebreaker ferry. Transportation Corridor	• Background • Moderate sensitivity • Visibility: bare earth; moderate due to proximity, distance and scale of project • Recommended as a KVA	Prolonged
12	• Alaska Range • 60°11'57.47"N 154°20'31.12"W • Port Alsworth: Lake Clark National Park	Mine Site and Transportation Corridor	• Background • Moderate sensitivity from the elevated position • Visibility: bare earth; moderate to high due to proximity, distance and scale of project • Recommended as a KVA	Intermittent
13	• Alaska Range • 59°57'10.05"N 154°52'2.07"WPort • Nondalton South Iliamna Lake	Mine Site and Transportation Corridor	• Background • Moderate to high sensitivity from the elevated position • Visibility: bare earth • Recommended as a KVA	Intermittent

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3.14 SOILS

This section describes the affected environment and current conditions related to three soil subresources:

1. Soil types and disturbance/removal;
2. Erosion; and
3. Soil chemical quality (Mine Site only).

Available literature directly associated with the Mine Site and Transportation Corridor components is limited to the Exploratory Soil Survey of Alaska (ESS), which was completed by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS; formerly known as the Soil Conservation Service) (Rieger et al. 1979). Literature provided by the NRCS generally covers a variety of baseline soil data intended to assist in land resource planning and management, including classifications based on soil taxonomy, drainage, slopes, vegetative growth potential, and suitability for various land uses and development.

The ESS is not sufficient for site-specific interpretations, but is useful as a general soils map. Soil taxonomy is periodically updated; therefore, some information provided in the ESS does not translate directly to the current 2006 classification system, *Keys to Soil Taxonomy, 10th edition* (Soil Survey Staff 2006). For example, two additional soil orders, which represent the highest categorical level, have been added since the ESS in 1979. Both additional soil orders occur in the project area: Andisols and Gelisols. Where applicable, soil descriptions from the ESS have been translated to current 2006 classification system equivalents (3PPI 2011). Corresponding equivalents are based on available ESS descriptions and extrapolations from other nearby studies for the village of Nondalton and Chisik Island (Table 3.14-1).

Table 3.14-1: Corresponding ESS and 2006 Classifications for Applicable Soils

ESS Map Units	1979 Classification	2006 Classification
HY4, SO11, IA7	Pergelic cryofibrists	Typic fibristels
SO11	Humic cryothods	Typic humicryods
IA7, IA9	Typic crandepts	Typic haplocryands Typic vitricryands

Notes:
ESS = Exploratory Soil Survey of Alaska
Source: Excerpt from Pebble Project EBD 2004 through 2008, Chapter 5. Soils, Table 5-2.

Descriptions of unconsolidated overburden at the Mine Site and other project components are provided in Section 3.15-Geohazards.

3.14.1 Common Soil Conditions

Common soil conditions that are considered to have minimal or no significance in the project area include permafrost occurrence and documented soil impairments from anthropogenic sources.

3.14.1.1 Permafrost

[Note: Section may be updated pending RFI information.]

To date, investigations and exploration programs in the project area (including all project components) have not reported permafrost. Permafrost may discretely occur in the project area; however, occurrence is presumed to be relict permafrost from prior glacial periods (Knight Piésold 2011).

Portions of the project area are near the reported southern limit of sporadic permafrost, which varies from 0 to 50 percent of the landscape subsurface (Ferrians 1965). More recent estimates indicate isolated permafrost distribution that coincides with project components on the western side of Cook Inlet (Jorgenson et al. 2008). Isolated permafrost varies from greater than 0 to 10 percent of the landscape subsurface. No permafrost occurrence is anticipated to coincide with project infrastructure on the eastern side of Cook Inlet. An assessment of existing thermokarst landscape features and future areas susceptible to thermokarst processes in the project footprint are generally considered low in coverage (Olefeldt et al. 2016). Thermokarst features are the result of permafrost freeze and thaw processes that create distinctive landforms; however, these features can also be residual expressions of where permafrost no longer exists.

Frozen ground conditions have been observed in near-surface soils in a few test pits and soil borings, but conditions were indiscernible from active layer processes that freeze and thaw annually at depths of up to 10 feet. Thermistor string (i.e., ground temperature) measurements from within the Mine Site study area reported a mean temperature of 39.1 degrees Fahrenheit (°F). Groundwater temperature measurements from the deposit area were also above freezing throughout the year. Although such conditions do not preclude the discrete occurrence of permafrost, current conditions do not support permafrost aggradation (e.g., development) or significant occurrence. Where present, relict permafrost is likely limited to areas where one or more favorable conditions exist, including shaded areas and north-facing slopes; poorly drained shallow surface soils overlain with insulative organics; and deep, coarse-grained soils (3PPI 2011). Based on information provided in the ESS, principal components associated with Pergelic Cryofibrists (HY4) and Typic Cryandepts (IA7) soil types in the project footprint may coincide with relict permafrost occurrence in areas of very poorly drained organic soils (e.g., fibrous sedge and muskeg) of nearly level association that include depressions and valley bottoms.

3.14.1.2 Soil Impairments

A review was conducted of the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program database. The database lists known contaminated sites and leaking underground storage tanks throughout Alaska. The database provides information regarding the type of contaminant released to the environment, the type(s) of media (air, water, soil, and rock) affected by the contaminant, the potential responsible party for the documented release, and the location where the release occurred (ADEC 2018a). One contaminated site (ADEC File Number 2333.38.031) is within 0.25 mile of the pipeline alignment on the eastern side of Cook Inlet. The nature of the release involved a 200-gallon fuel oil spill at a private residence. Based on the release description, impairments to soils within the project footprint are not likely.

[Note: Section may be updated pending RFI 011 information.]

3.14.2 Mine Site

3.14.2.1 Soil Types

Each soil map unit (Figure 3.14-1) denotes the major soils components and one or more minor components. Because of the map scale, the minor components were not mapped separately. The soil types (i.e., primary principal component) and the corresponding acreages associated with the Mine Site are listed below.

- IA9 Typic Cryandepts – 4,960 acres: Very gravelly, hilly to steep association. Soils are well-drained, strongly acidic, and formed in volcanic material with a thin surface cover of decomposed plant matter mixed with volcanic ash. Common vegetation includes alder, grasses, or low shrubs.
- IA7 Typic Cryandepts – 1,915 acres: Very gravelly, nearly level to rolling Peregelic Cryofibrists, nearly level association. Soils are also associated with rolling plains bordering Iliamna Lake and rolling ground moraines, terminal moraines, outwash plains, and paleo beach ridges, small lakes, and muskegs. Typic Cryandepts are well-drained, acidic, and formed in shallow volcanic material over gravelly glacial material dominated by low-tundra vegetative species. Shallow permafrost can reportedly be associated with a Pergelic Cryofibrists component (where present) consisting of sedge peat muskegs and coarse acid moss.

Figure 3.14-1: Soil Types Associated with Mine Site and Transportation Components

3.14.2.2 Erosion

Erosion resulting from surface and subsurface soil disturbances would be attributed to both wind and hydraulic processes. Exposed finer-grained soils are generally more susceptible to removal and transport by wind. Flowing water over ground surfaces results in hydraulic erosion that also removes and transports soils. Downslope movement of surface materials from other slope instability processes (e.g., landslides, solifluction) are presented in Section 3.15-Geohazards.

Numerous conditions can influence a soils' susceptibility to wind and hydraulic erosion. Such conditions include weather (e.g., wind, precipitation), season (e.g., ground freeze), soil type and slope angles, and severity of disturbance. In most circumstances, soil disturbances and subsequent exposure would accelerate erosion by wind and water. Possible consequences of erosion include sediment loading in surface water runoff, and alteration of soil profile characteristics and ecological communities.

Measures of soil susceptibility to wind erosion provided by NRCS include (where present) a "hazard of erosion" description and a published wind erodibility group (WEG) value; hazard of erosion descriptions range from none (i.e., N/A) to slight, moderate, and severe. The WEG is based on soil surface layer characteristics, and ranges between 1 and 8. Soils most susceptible to wind erosion have a WEG value of 1, while those least susceptible (e.g., bedrock, frozen soils, or saturated soils) would have a WEG value of 8. Neither of these soil erosion descriptors for wind is provided in the ESS.

Multiple conditions can influence hydraulic erosion, including specific soil properties such as texture, cohesion and vegetative cover, as well as seasonal conditions, precipitation, slope angle and length, and flow velocities. Finer-grained soil types such as silt and sand are generally more susceptible to erosion than gravels and coarser material.

Measures of soil susceptibility to hydraulic erosion provided by NRCS include (where present) a "hazard of erosion" description and K-factor values (erosion factor values); hazard of erosion descriptions range from none to slight, moderate, and severe. The K-factor is a relative index of soil susceptibility removal and transport due to runoff. Where available, erosion factor (Kw) was preferentially used to evaluate hydraulic erosion susceptibility. The Kw value indicates the erodibility of the whole soil. K-factor values are grouped into 14 classes ranging from 0.02 to 0.69. Higher values correspond to increased erosion vulnerability. Erosion factor values (K) that are indicative of increased erosion rates and runoff susceptibility are generally greater than 0.4 (IWR 2002). None of these soil erosion descriptors for water are provided in the ESS.

The ESS does not provide wind and water erosion descriptors (i.e., suitability ratings) for all soil types; and where present, are limited to unique physical conditions or soil types. None were listed for map units corresponding to the Mine Site; however, inferences can be made assuming surface cover is removed or disturbed. Both soil types are associated with the presence of alternating layers of finer-grained volcanic ash with coarser gravel materials. Fine-grained volcanic ash constituents would be more susceptible to erosion by both water and wind relative to coarser gravel materials (where present). Wind erosion susceptibility is anticipated to be similar for both soil conditions in the Mine Site area. Erosion by water would be greater for soils on hilly to steep associations (i.e., IA9), in comparison to nearly level or rolling terrain (i.e., IA7).

[Note: Section above may be updated pending updated project description information.]

3.14.2.3 Soil Chemistry

A baseline soil chemistry description is provided for the Mine Site to compare anticipated effects resulting from the deposition of fugitive dust from sources of concern. Fugitive dust sources of concern at the Mine Site include mining operations; material (e.g., rock) storage, processing, and handling (including concentrate); tailings storage; and repurposing materials derived from the Mine Site (e.g., aggregates).

Upland soil chemistry baseline data are not included in this discussion for the Transportation Corridor and Natural Gas Pipeline Corridor. Neither of these components under planned operations have significant mechanisms or chemical sources that could result in adverse impacts to soil conditions. Potential sources that could impact soils associated with these components may include dust from road bed aggregates or transported concentrates, but neither is considered a significant mechanism or source. Material (e.g., aggregate) sites in the Transportation Corridor and Natural Gas Pipeline Corridor are well outside the Pebble Deposit. Therefore, pending material suitability evaluations, the material sources are not expected to introduce significant chemical impairments to soil. Transportation of concentrates from the Mine Site will be in sealed containers with locking lids, and transfers would be conducted at offshore facilities. Furthermore, surface soil conditions associated with the Transportation Corridor and Natural Gas Pipeline Corridor are chemically consistent with those described for the Mine Site study area (SLR Alaska Inc. et al. 2011a).

A total of 237 primary surface soil samples was collected from 117 locations in the Mine Site study area to evaluate naturally occurring constituents (NOCs) (Figure 3.14-2). Surface samples were collected to a depth of 0.5 foot. The presence of trace elements, cyanide, and sodium was analyzed at 237 surface soil locations; anions and cations at 235 degree surface sample locations; petroleum hydrocarbons as diesel-range organics (DRO) and residual-range organics (RRO) at 23 surface soil locations; and total organic carbon (TOC) at 53 surface sample locations. The sample locations were considered representative of undisturbed baseline conditions. A list of NOCs (i.e., analytes) evaluated as part of the surface soil studies is presented in Table 3.14-2 and Table 3.14-3.

All trace elements (mostly metals) evaluated were detected in some of the surface samples above detection limits. Although reported concentrations of most NOCs were generally low and consistent with undeveloped areas of Bristol Bay drainages, some locations reported elevated NOCs at levels considered adverse in literature. Variations in up to 16 different landform types and seven different habitat types reportedly influenced the ranges of elemental concentrations throughout the study area (SLR Alaska Inc. et al. 2011b).

Iron and aluminum are the most abundant elements reported throughout the Mine Site study area surface soils, followed by calcium and magnesium (Table 3.14-2). Concentrations of other trace elements were substantially lower. Trace elements with the lowest average concentrations included mercury and silver. The relative distribution of trace elements in the Mine Site study area surface soils is generally consistent with those reported across the United States, based on published U.S. Geological Survey evaluations. Comparison of co-located shallow subsurface soil sample results (i.e., 18 inches in depth) reported similar relative and mean concentrations of trace elements; however, less variability among sample locations was observed (where present). Notable deviations include those associated with bismuth and mercury. The mean concentration of bismuth and mercury in surface soil is 13 and two times greater, respectively, than shallow subsurface soil (SLR Alaska Inc. et al. 2011a).

Anions and cations evaluated in surface soil samples included chloride, cyanide, fluoride, sulfate, ammonia (as nitrogen) and sodium. The highest mean concentration among evaluated ions was ammonia, followed by sodium. The lowest mean concentration among evaluated ions was cyanide. Depth-based variations in ion concentrations were apparent based on comparison to co-located shallow subsurface soil sample results. Mean concentrations of cyanide and ammonia were greater in surface samples, while mean sulfate concentrations were greater in shallow subsurface samples (SLR Alaska Inc. et al. 2011a).

RRO hydrocarbons were detected at all 23 surface sample locations, and DRO was detected at 13 surface sample locations. Mean concentrations of 209 milligrams per kilogram (mg/kg) and 2,028 mg/kg were reported for DRO and RRO, respectively (Table 3.14-3). The elevated presence and wide range of reported hydrocarbon concentrations are attributed to naturally occurring biogenic sources, based on absence of prior disturbances, analytical fingerprint methods, and presence of TOC (SLR Alaska Inc. et al. 2011b). Similarly, mean hydrocarbon concentrations in corresponding shallow subsurface samples (where present) were significantly lower due to the absence of biogenic influences (SLR Alaska Inc. et al. 2011a).

Similar to hydrocarbons, reported TOC concentrations varied significantly. TOC concentrations varied from 0.36 percent to 65.1 percent among surface soil locations. The wide range is attributed to variable quantities of organic material retained in sampled matrices during collection. A mean TOC concentration of 6.51 percent was reported for the Mine Site study area. Mean TOC concentrations in corresponding shallow subsurface samples (where present) were also lower due to a diminished presence of biogenic influences (SLR Alaska Inc. et al. 2011a).

Because arsenic, copper, and lead are considered key trace elements associated with the deposit, additional depth-based statistical evaluation and temporal variation in concentrations at select sample locations were performed. No significant findings were identified through these activities (SLR Alaska Inc. et al. 2011a). Fugitive dust concerns associated with the Mine Site are further evaluated in Chapter 4, Environmental Consequences.

Figure 3.14-2: Mine Site Study Area Surface Soil Sample Locations

Table 3.14-2: Mine Site Study Area Surface Soil Trace Elements and Cations

Analyte	Frequency of Detection[a]	Percent Detected	Range of Detects (mg/kg) (Min-Max)	Range of Method Detection Limits (mg/kg) (Min-Max)	Range of Method Reporting Limits (mg/kg) (Min-Max)	Mean[b] (mg/kg)	Median[b] (mg/kg)	Standard Deviation[b]	Coefficient of Variation	Comparative Action Levels[c] (mg/kg)
Trace Elements										
Aluminum	237/237	100%	932-109000	.67 – 100	2.14 – 500	17644	16400	12175	0.69	N/A
Antimony	211/237	89%	0.040 – 2.14	0.033 – 2.13	0.11 – 6.86	0.24	0.20	0.22	0.93	41
Arsenic	227/237	96%	1.03 – 73.8	0.30 – 21.3	0.50 – 68.6	10.2	8.07	10.1	0.99	8.8 (inorganic)
Barium	237/237	100%	14.8 - 576	0.050 – 10.0	0.30 – 50.0	84.9	65.5	67.1	0.79	20,000
Beryllium	224/237	95%	0.051 – 5.89	0.033 – 2.13	0.11 – 6.86	0.41	0.34	0.45	1.09	200
Bismuth	105/237	44%	0.073 – 1.05	0.066 – 20.0	0.21 – 100	1.30	0.13	4.26	3.27	N/A
Boron	65/237	27%	0.54 – 9.34	0.36 – 50.0	1.16 – 117	4.82	3.45	4.62	0.96	N/A
Cadmium	146/237	62%	0.072 – 3.06	0.050 – 4.26	0.21 – 13.7	0.24	0.16	0.32	1.33	92 (Diet)
Calcium	237/237	100%	222 – 31100	10.0 – 645	31.9 – 2060	2577	1700	2993	1.16	N/A
Chromium	233/237	98%	1.15 – 113	0.050 – 8.24	0.30 – 27.5	17.7	14.7	14.5	0.82	1.0×10^5 (Cr^3) 3.9 (Cr^6)
Cobalt	232/237	98%	0.45 – 24.2	0.030 – 10.3	0.10 – 34.3	6.55	5.63	4.60	0.70	N/A
Copper	236/237	100%	2.65 – 197	0.19 – 12.4	0.64 – 41.2	27.4	16.3	35.2	1.28	4100
Iron	237/237	100%	588 – 103000	2.00 – 452	4.00 – 1460	20694	19300	13532	0.65	N/A
Lead	236/237	100%	0.66 – 78.4	0.050 – 4.26	0.21 – 13.7	8.74	7.54	8.85	1.01	400
Magnesium	237/237	100%	74.1 – 9930	10.0 – 795	31.9 – 2540	3076	2930	2022	0.66	N/A
Manganese	237/237	100%	5.43 – 6560	0.066 – 50.0	0.21 – 300	388	279	559	1.44	N/A
Mercury	224/237	95%	0.014 – 0.72	0.013 – 0.30	0.042 – 2.00	0.12	0.072	0.12	0.98	3.1 (elemental)
Molybdenum	179/237	76%	0.40 – 68.1	0.30 – 21.3	1.00 – 68.6	1.82	0.92	4.71	2.59	N/A

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Table 3.14-2: Mine Site Study Area Surface Soil Trace Elements and Cations

Analyte	Frequency of Detection[a]	Percent Detected	Range of Detects (mg/kg) (Min-Max)	Range of Method Detection Limits (mg/kg) (Min-Max)	Range of Method Reporting Limits (mg/kg) (Min-Max)	Mean[b] (mg/kg)	Median[b] (mg/kg)	Standard Deviation[b]	Coefficient of Variation	Comparative Action Levels[c] (mg/kg)
Nickel	235/237	99%	0.59 – 53.8	0.066 – 4.26	0.21 – 13.7	9.16	7.42	7.10	0.77	1,700 (soluble salts)
Potassium	224/237	95%	100 – 5510	30.0 – 2130	106 – 6860	621	511	523	0.84	N/A
Selenium	219/237	92%	0.18 – 79.3	0.050 – 10.3	0.30 – 34.3	2.76	1.10	7.34	2.66	510
Silver	117/237	49%	0.030 – 1.45	0.030 – 2.13	0.10 – 6.86	0.11	0.059	0.20	1.80	510
Thallium	179/237	76%	0.0099 – 5.00	0.0066 – 5.00	0.021 – 30.0	0.24	0.088	0.61	2.53	1.0 (soluble salts)
Tin	27/237	11%	1.06 – 2.90	0.33 – 21.3	1.06 – 100	1.94	0.96	2.99	1.54	N/A
Vanadium	210/237	89%	4.67 – 227	0.10 – 64.5	0.50 – 206	46.4	47.0	31.1	0.67	510
Zinc	235/237	99%	2.77 – 228	0.33 – 21.3	1.06 – 68.6	43.9	40.0	33.2	0.76	30,000
Anions and Cations[d]										
Ammonia (as nitrogen)	214/235	91%	0.50 – 2200	0.50 – 120	3.00 – 382	363	179	440	1.21	N/A
Chloride	158/237	67%	0.40 – 28.3	0.30 – 30.0	0.98 – 100	2.74	1.50	3.73	1.36	N/A
Cyanide	199/237	84%	0.028 – 0.75	0.024 – 4.00	0.049 – 20.0	0.19	0.15	0.18	0.92	34 (CN^-)
Fluoride	54/235	23%	0.33 – 39.3	0.30 – 18.4	0.98 – 59.5	0.88	0.36	2.67	3.04	N/A
Sodium	215/237	91%	56.2 – 1860	30.0 – 2130	106-6860	208	153	181	0.87	N/A
Sulfate	211/237	90%	0.41 – 1820	0.30 – 30.0	0.98 – 100	19.8	4.26	122	6.19	N/A

Notes:

a. Number of samples with detectable concentrations / total number of samples analyzed.

b. When calculating the mean, median, and standard deviation, non-detect results were included as one-half the method detection limit. Non-detect results assigned a "U" or "UJ" qualifier were included as one-half the reporting limit.

c. Where provided, comparative action level is based on ADEC 18 AAC 75, Oil and Other Hazardous Substances Pollution Control, November 7, 2017, Table B1. Method Two – Soil Cleanup Levels, Human Health, Under 40 Inch Zone (ADEC 2018b).

d. All data presented on a dry-weight basis.

mg/kg = milligram per kilogram
Min = minimum
Max = maximum
N/A = none available
Source: Excerpt: Pebble Project EBD 2004 through 2008, Chapter 10. Trace Elements and Other Naturally Occurring Constituents Bristol Bay Drainages, Table 10.1-3.

Table 3.14-3: Mine Site Study Area Surface Soil Diesel Range Organics and Residual Range Organics, and Total Organic Carbon

Analyte	Frequency of Detection[a]	Percent Detected	Range of Detects (mg/kg) (Min-Max)	Range of Method Detection Limits (mg/kg) (Min-Max)	Range of Method Reporting Limits (mg/kg) (Min-Max)	Mean[b] (mg/kg)	Median[b] (mg/kg)	Standard Deviation[b]	Coefficient of Variation	Comparative Action Levels[c]
DRO[d]	13/23	57%	11.7 – 1300	2.01 – 127	20.1 – 1270	209	72.5	299	1.43	10,250
RRO[d]	23/23	100%	32.7 – 12,300	2.01 – 127	20.1 – 1270	2,028	1150	2,895	1.43	10,000
TOC[d,e]	53/53	100%	0.3% – 65.1%	0.00026% – 2.08%	0.0061% – 4.16%	6.51%	2.20%	12.6%	1.93	N/A

Notes:

a. Number of samples with detectable concentrations / total number of samples analyzed.

b. When calculating the mean, median, and standard deviation, non-detect results were included as one-half the method detection limit. Non-detect results assigned a "U" or "UJ" qualifier were included as one-half the method reporting limit.

c. Where provided, comparative action level is based on ADEC 18 AAC 75, Oil and Other Hazardous Substances Pollution Control, November 7, 2017, Table B2. Method Two – Petroleum Hydrocarbon Soil Cleanup Levels, Ingestion, Under 40 Inch Zone (ADEC 2018b).

d. All data presented on a dry-weight basis.

e. For TOC, unit of measure is percentage rather than milligrams per kilogram (mg/kg).

DRO = diesel range organics
mg/kg = milligram per kilogram
Min = minimum
Max = maximum
N/A = none available
RRO = residual range organics
TOC = total organic carbon
Source excerpt: Pebble Project EBD 2004 through 2008, Chapter 10. Trace Elements and Other Naturally Occurring Constituents Bristol Bay Drainages, Table 10.1-5.

3.14.3 Transportation Corridor and Amakdedori Port

3.14.3.1 Soil Types

Because land-based portions of the Natural Gas Pipeline Corridor on the western side of Cook Inlet would be buried in the road bed prism of the Transportation Corridor, soil types for both the Transportation and Natural Gas Pipeline corridors are collectively described in this section, in addition to those present at the Amakdedori Port.

The ESS recognized five soil map units in the Transportation Corridor study area within the Bristol Bay region. The map units are delineated on Figure 3.14-1 and are described below.

The soil types and the corresponding acreages associated with transportation components are as follows:

- IA7 Typic Cryandepts – 443 acres (see Section 3.14.1.2-Soil Impairments for description);
- IA9 Typic Cryandepts – 210 acres (see Section 3.14.1.2-Soil Impairments for description)
- IA17 Dystric Lithic Cryandepts – 640 acres: Hilly to steep association. Soils are associated with low hill and ridges bordering mountainous areas. Well-drained loamy soils are formed in thixotropic ash over shallow (20 inches) metamorphic bedrock or gravelly till, and overlain with a thin layer of organic material.
- HY4 Pergelic Cryofibrists – 32 acres: Nearly level association. Soils are associated with nearly level, broad, wet lowlands near lakes and coastal margins. Organic-rich sedge and moss (i.e., muskeg) soils underlain by silt and sand mixtures are poorly drained and can reportedly be associated with the presence of shallow permafrost. Vegetation includes water-tolerant sedges, low shrubs, and black spruce.

The Amakdedori Port site is on the western shore of Cook Inlet north of Amakdedori Creek; is generally level; and includes upland (shore-based) soil types that transition seaward to intertidal dunes and a gravel-lined shoreline. Soil types associated with the Amakdedori Port and immediate area are limited to soil map unit IA17.

3.14.3.2 Erosion

The ESS does not provide wind and water erosion descriptors (i.e., suitability ratings) for all soil types, and where present, are limited to unique physical conditions or soil types. None were listed for map units corresponding to the Transportation Corridor; however, generalized inferences can be made assuming surface cover is removed or disturbed. Soil conditions associated with soil map unit IA17 are likely the most susceptible to wind and hydraulic erosion processes in the Transportation Corridor (including Amakdedori Port). This is attributed to the presence of finer-grained, loamy materials overlying shallow bedrock on hilly to steep slopes. Soils associated with soil map unit IA9 would also be more susceptible to hydraulic erosion, based on the occurrence in hilly to steep terrain. Soils associated with soil map units IA7 and HY4 are likely the least susceptible to hydraulic erosion in the Transportation Corridor, based on associations with nearly level terrain. However, information provided in the ESS is broadly based, and is not intended to be used for site-specific information.

3.14.4 Natural Gas Pipeline Corridor

[Note: Section may be updated pending updated project description information.]

3.14.4.1 Soil Types

The Natural Gas Pipeline Corridor on the eastern side of Cook Inlet extends from Alaska Department of Transportation & Public Facilities (ADOT&PF) land north of Anchor Point to tie in with an existing pipeline near Happy Valley, and parallels the Sterling Highway right-of-way (ROW). The most detailed resource for soil data along this pipeline segment is the USDA NRCS Soil Survey of Western Kenai Peninsula Area, Alaska. A total of 11 detailed soil map units coincides with the pipeline footprint (Figure 3.14-3). The soil descriptions provided below address soil map units that cover more than 1 acre of the 30-foot-wide operational corridor ROW footprint. Soil map units that cover less than 1 acre are also provided, with water and wind erosion descriptors only.

- 572 – Island silt loam, forested, 0 to 8 percent slopes, 15 acres: Medial over loamy, amorphic over mixed, superactive Pachic Fulvicryands. Soils are associated with till plains supporting a lutz spruce forest with willow and bluejoint reedgrass understory. Soils consist of a very fine sandy loam, silt loam overlain by a thin interval of plant material. Soils are well–drained with no flooding or ponding, with a slight hazard of erosion for water, but severe by wind.
- 640 – Qutal silt loam, 0 to 4 percent slopes, 8 acres: Medial over loamy, amorphic over mixed, superactive Aquandic Haplocryods. Soils are associated with moraines on till plains and depressions on till plains dominated by a spruce-birch forest spruce-willow community. Soils consist of very gravelly sand overlain with silt loam and a thin interval of decomposed plant material. Soils are somewhat poorly drained with no flooding or ponding, with a slight hazard of erosion for water, but severe by wind.
- 617 – Mutnala silt loam, 0 to 4 percent slopes, 6 acres: Medial over loamy, amorphic over mixed, superactive Andic Haplocryods. Soils are associated with moraines on till plains dominated by spruce-birch forest. Soils consist of gravelly sandy loam overlain with silt loam and decomposed plant material. Soils are well–drained with no flooding or ponding, with a slight hazard of erosion for water, but severe by wind.
- 568 – Island silt loam, 0 to 4 percent slopes, 3 acres: Medial over loamy, amorphic over mixed, superactive Pachic Fulvicryands. Soils are associated with till plains dominated by shallow kettles. Soils consist of gravelly sandy loam overlain with silt loam and a thin interval of decomposed plant material. Soils are well-drained with no flooding or ponding with a slight hazard of erosion for water, but severe by wind.
- 570 – Island silt loam, 8 to 15 percent slopes, 1 acre; severe hazard of erosion for water and wind; well-drained.
- 611 – Killey and Moose River soils, 0 to 2 percent slopes, 1 acre; slight hazard of erosion for water, severe by wind; poorly drained.
- 618 – Mutnala silt loam, 4 to 8 percent slopes, 1 acre; moderate hazard of erosion for water, severe by wind; well-drained.
- 619 – Mutnala silt loam, 8 to 15 percent slopes, 1 acre; severe hazard of erosion for water and wind; well–drained.
- 698 - Tuxedni silt loam, warm, 0 to 8 percent, 1 acre; slight hazard of erosion for water, severe by wind; somewhat poorly drained.
- 706 – Whitsol silt loam, 0 to 4 percent slopes, 1 acre; slight hazard of erosion for water, severe by wind; well-drained.
- 707 – Whitsol silt loam, 4 to 8 percent slopes, 1 acre; moderate hazard of erosion for water, severe by wind; well-drained.

3.14.4.2 Erosion

Available NRCS data for the area include a land capability classification. This classification provides a general suitability index for agriculture or farming (USDA 2005). Land capability classifications for all soils in the pipeline footprint are considered to have severe limitations.

Soils in the pipeline footprint are predominantly susceptible to wind erosion, assuming disturbance and removal of surface cover. All soil map units greater than 1 acre have a severe hazard of erosion rating for wind, and WEG ratings of 2 that correspond to highly erodible soils. All soil map units greater than 1 acre are considerably less susceptible to erosion by water, with hazard of erosion ratings of "slight." This corresponds to erosion factors (Kw) ranging from 0.24 to 0.47.

Figure 3.14-3: Soil Types for West Cook Inlet Natural Gas Pipeline Corridor

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3.17 HYDROGEOLOGY

The project area is in a sparsely populated area of southwestern Alaska near Iliamna Lake, and comprises four primary components with diverse hydrogeological settings: the Mine Site where the Pebble Deposit is located, a Transportation Corridor, a Natural Gas Pipeline, and a port site at Amakdedori on Cook Inlet. A description of groundwater flow processes and the hydrogeology of each of these areas are provided below. Permafrost is not found in the project area.

3.17.1 Mine Site

This section focuses on existing groundwater conditions in areas of the Mine Site that are anticipated to be the most affected by project activities. The open pit and associated dewatering pose the most significant risk to groundwater quantity, because the pit would be relatively large and deep, requiring extraction of water to allow for mining operations. Dewatering would create a relatively large zone of influence around the open pit, in which groundwater levels and groundwater, surface water interactions, and surface water flows would be affected. Groundwater withdrawal for potable water supply or mineral processing may also influence groundwater and surface water levels and flow. Groundwater seepage and flow pathways away from the tailings storage facility (TSF), low-grade ore (LGO) stockpile, and water management ponds are also of concern with regard to potential contaminant migration. An evaluation of existing groundwater quality is provided in Section 3.18-Water Quality.

The physiography and geology of the Mine Site are presented in Section 3.13-Geology, and are summarized here to describe the hydrogeologic setting. The Pebble Deposit area straddles a watershed divide between the headwaters of the South Fork Koktuli River and Upper Talarik Creek, and is primarily on an east-facing slope and valley floor ranging in elevation from 950 feet to 1,400 feet.

Bedrock includes a mixture of mineralized sedimentary, volcanic, and intrusive rocks, which are overlain by overburden on both the eastern and western sides, as shown on Figure 3.13-1 and Figure 3.13-2. The mineralized bedrock is overlain by Tertiary sedimentary rocks on the eastern side of the Mine Site, which form a wedge that thickens toward the east to approximately 1,500 feet. Further east, where the Tertiary sedimentary rocks have been downthrown by approximately 4,000 feet, a narrow graben structure has been filled with volcanic flows. West of the graben is a well-cemented conglomerate overlain by interbedded sedimentary and volcanic rocks. The definition of the bedrock surface was established through drilling at the Mine Site between 2004 and 2012 (Schlumberger 2011, 2015).

The surficial geology in the Iliamna Quadrangle has previously been described by Detterman and Reed (1973) and Detterman (1986). In the Mine Site analysis area, the surficial deposits have been described by Hamilton and Klieforth (2010), and are discussed in detail in Schlumberger (2011). More recent drilling investigations have resulted in minor refinements to surficial geology in Schlumberger (2015), which are reflected on Figure 3.13-2. The overburden at the Mine Site consists primarily of interbedded glaciolacustrine and glaciofluvial sediments.

3.17.1.1 Groundwater Flow Processes

Inputs to the groundwater flow system include precipitation (groundwater recharge) and leakage from surface water features. The primary outputs from the groundwater flow system at the Mine Site include discharge to surface water features and springs. The water table is generally a subdued replica of ground surface topography, whereby it is deepest below ridge tops, and near ground surface in valley bottoms.

Precipitation is primarily the result of marine storm systems, which are greatest from late summer to early winter. Precipitation is greater on upland areas than in lowland areas due to orographic effects. The measured long-term average annual precipitation is approximately 27 inches at the Iliamna Airport, and is estimated to be on the order of 50 inches near the Pebble Deposit. Additional climate data are provided in Section 3.20-Air Quality.

Groundwater generally flows from upland areas to valley bottoms according to horizontal and vertical hydraulic gradients, eventually discharging to surface water features. Upper-elevation seeps have been observed in some areas due to the presence of fine-grained deposits in valley bottoms, which restrict groundwater discharge. The majority of the groundwater flow is in the most permeable deposits, which include valley bottom outwash sands and gravels, and the uppermost 50 feet of bedrock that is highly fractured due to physical and chemical weathering since retreat of the glaciers in the area. Groundwater flow in deep bedrock is limited by lower hydraulic conductivity. Although higher-permeability faults and fractures have been identified, the flow pathways along the faults are localized and appear to terminate in the study area. Therefore, they are not anticipated to function as preferential groundwater flow pathways at the regional scale.

3.17.1.2 Hydrogeological Characterization

The objectives of the hydrogeological characterization program at the Mine Site (Schlumberger 2011, 2015) were to characterize the existing groundwater flow regime in the study area, and define how the local groundwater flow regime interacts with the regional groundwater flow system. A complementary objective was to evaluate the nature and degree of interactions between groundwater and surface water to inform the understanding of aquatic, fish resource, and wetlands habitat. To meet these objectives, a significant amount of hydrogeological characterization work has been undertaken. The results of these characterization programs form the basis for a baseline groundwater flow model and a water balance and water quality model.

Hydrogeological data were collected during the course of several field programs between 2004 and 2012, which involved logging of borings, installation of pumping wells, piezometers, and monitoring wells, permeability testing, streamflow gauging, monitoring of meteoric inputs and routine monitoring of groundwater levels, and collection of streamflow and groundwater quality data (Figure 3.17-1).

Boreholes were advanced using a variety of drilling techniques, including mud rotary, air rotary ODEX, and rotary sonic, with sampling and logging conducted according to standard methods defined by the American Society for Testing and Materials (ASTM), and consistent with best industry practice.

Instrumentation installed prior to 2008 included the following: 39 nested monitoring wells at 21 locations, 240 nested piezometers at 103 locations, 216 single piezometers, one deep multi-level groundwater instrumentation system, nine cross-hole aquifer test wells at eight locations, and 70 piezometers installed as part of the wetlands program. In 2011, an additional 43 boreholes were drilled in the deposit area for geotechnical purposes, and several response tests were conducted to determine bedrock permeability. In 2012, an additional 18 boreholes were drilled to further investigate hydrogeology.

Piezometers were installed to depths of up to 232 feet below ground surface to collect information on stratigraphy, hydraulic conductivity, and groundwater levels at each site. Vertical groundwater gradients were also characterized where a cluster of piezometers was installed near the same location. A number of piezometers were also installed as part of the geotechnical characterization program for the purposes of water level monitoring and permeability testing.

Figure 3.17-1: Location of Hydrogeologic Investigations at the Mine Site

Note: Figure under development, GIS data requested in RFI.

Between 2004 and 2008, a total of nine pumping wells was installed using air rotary drilling techniques and telescopic well screens targeting the most permeable features encountered during drilling. In 2012, a further four pumping wells were installed using sonic drilling techniques to understand the requirements for pit dewatering, but these wells have not yet been tested.

[Note: RFI 019 requests groundwater model results based on the proposed mine plan in PLP (2017). This section will be updated after receipt of response with data collected since 2012 that may be incorporated into the current groundwater model.]

Single-well response tests were completed by displacing groundwater in the well and monitoring recovery until water levels stabilized. Prior to commencement of each test, static water levels were measured, and pressure transducers installed. Falling and rising head slug tests were conducted on monitoring wells and piezometers to determine the hydraulic conductivity of the surrounding overburden or bedrock formations.

In 2006, a multi-level piezometer system (WB-1) was installed in the Pebble Deposit area in a borehole drilled to a depth of 4,050 feet for mineral exploration purposes. After flushing the borehole, an assembly of 50 hydraulic head measurement ports and 24 sampling ports were installed to facilitate monthly monitoring of hydraulic head and groundwater quality to significant depths below the deposit. Cross-hole testing was also completed to allow for measurement of hydraulic conductivity for a larger volume of rock, as compared to response testing and packer testing.

In 2010, an additional multi-level piezometer system (WB-3) was installed to a depth of approximately 600 feet to improve characterization of the area between tributaries NK1.190 and SK1.190. The primary objective was to characterize groundwater levels and gradients, and confirm groundwater flow directions. In 2012, a third multilevel system (WB-4) was installed in the pre-Tertiary bedrock in the western portion of the Pebble Deposit area to a depth of 2,250 feet. The primary objective was to characterize groundwater levels and gradients in the deposit area.

Larger-scale pumping tests were conducted in three areas, including the area around the Pebble Deposit, at four locations downgradient of the Pebble Deposit near the South Fork Koktuli River, and in the North Fork Koktuli drainage area. Pumping tests were conducted in both overburden and bedrock using air lift pumping techniques for between 6 and 24 hours. Step tests were completed to determine the specific capacity of the pumping wells and a pumping rate for the constant-rate tests. Water levels and pumping well discharge were monitored in both the pumping wells and nearby monitoring wells using pressure transducers and manual water level meters during both pumping and recovery phases to allow for determination of aquifer properties.

Monthly water level monitoring was conducted in monitoring wells from 2005 through 2012 using manual water level probes; or calculated based on piezometric pressure measurements by vibrating wire piezometers, and at measurement ports in the multi-level piezometer systems.

In support of the characterization of the physical groundwater flow system, a groundwater quality characterization program was also conducted. The program involved sampling of groundwater and seepage quality on a quarterly schedule, and is described in Section 3.18-Water Quality. Field chemistry and flow measurements were collected at weirs to support development of the site water balance and water quality modeling.

Hydrostratigraphic Units

Twenty-six cross-sections were produced to illustrate the distribution of hydrogeologic units in overburden (Schlumberger 2015: Appendix 8.1B]). Four of these cross-sections are shown on Figure 3.17-2 through Figure 3.17-5 to provide a representative depiction of these units at the Mine Site. In addition, a groundwater contour map is provided on Figure 3.17-6 to illustrate flow patterns described below. The cross-sections illustrate that the surficial geology is variable—both laterally, and with depth—which is consistent with regional geologic mapping. The distribution and characteristics of the overburden and bedrock aquifers in the study area are summarized in Table 3.17-1.

Figure 3.17-2: Cross-section E-10 – Pebble Deposit Area

Figure 3.17-3: Cross-section L-1 – Frying Pan Lake and South Fork Koktuli Drainage

Figure 3.17-4: Cross-section M-1 – North Fork Koktuli Drainage

Figure 3.17-5: Cross-section M-1 – South Fork Koktuli Discharge Area

Figure 3.17-6: Shallow Groundwater Contours, April 2011, Seasonal Low Water

Table 3.17-1: Summary of Hydrostratigraphic Units

Drainage/ Catchment	Area/ Sub-Catchment (*Project Facility*)	Overburden or Bedrock	Aquifers	Description
South Fork Koktuli Drainage	Pebble Deposit Area (*Open Pit*)	Overburden	Surficial Aquifer (multiple)	Clean sand; sand and gravel.
			Intermediate Aquifer	Sand and gravel between silty deposits.
			Deep Aquifer	Not described.
		Bedrock	Weathered Bedrock Aquifer	Uppermost 10 to 50 feet of bedrock. Felsenmeer[1] where exposed.
			Upper Bedrock Aquifer	Below weathered bedrock, from 50 to 600 feet in depth.
			Fault Zones	Functions as both conduits and barriers to groundwater flow.
	Frying Pan Lake Area (*South WTP Discharge*)	Overburden	Surficial Aquifer (multiple)	Clean sand; sand and gravel.
			Intermediate Aquifer	Sand and gravel between silty deposits.
			Deep Aquifer	Sand and gravel overlying bedrock thickens toward Frying Pan Lake.
		Bedrock	Weathered Bedrock Aquifer	Uppermost 10 to 30 feet of bedrock.
	South Fork Koktuli Flats	Overburden	South Fork Koktuli Valley Aquifer	Clean sand and gravel moraine from silty terminal moraines downstream of Frying Pan Lake. Continuous with outwash, terrace, and alluvial sand and gravel deposits in valley to west.
			South Fork Koktuli Channel Aquifer	Gravels of alluvial and glaciofluvial origin along the channel from downstream of Frying Pan Lake to bedrock high to the east.
			MW11 Aquifer	Sand and gravel near monitoring well MW11.
			Surficial Aquifer	Outwash sand and gravel between South Fork Koktuli River and slope of Upper Talarik Creek Valley.
			Intermediate Aquifer	Below surficial aquifer; conveys majority of flow from South Fork Koktuli River Aquifer and MW11 Aquifer to Upper Talarik Creek Tributary UT1.190[2].
			Deep Aquifer	Sand and gravel; silty sand.
	South Fork Koktuli Discharge Area	Overburden	South Fork Koktuli Valley Aquifer	Outwash sands and gravels; terrace gravels; alluvium. Extends from approximately 1 mile upstream of the confluence of the South Fork Koktuli River and SK1.190 to approximately 2.4 miles downstream.
North Fork Koktuli Drainage	Big Wiggly Basin	Overburden	Surficial Aquifer	Sand and gravel. Limited characterization of lateral and vertical extent.

Table 3.17-1: Summary of Hydrostratigraphic Units

Drainage/ Catchment	Area/ Sub-Catchment (*Project Facility*)	Overburden or Bedrock	Aquifers	Description
	Area E (*LGO Stockpile*)	Overburden	Intermediate Aquifer	Sand and gravel below glacial till.
		Bedrock	Weathered Bedrock Aquifer	Uppermost portion of bedrock.
	Area G (*TSF*)	Overburden	Surficial Aquifer	Thin aquifer composed of colluvium, drift, undifferentiated gravel, and undifferentiated drift.
		Bedrock	Weathered Bedrock Aquifer	Uppermost portion of bedrock.
	North Fork Glacial Outwash Area (*TSF Main Embankment Seepage Collection and Sediment Ponds*)	Overburden	North Fork Outwash Aquifer	Outwash sand and gravel; alluvium.
			Terrace and Alluvial Deposits	Sand and gravel downstream of North Fork Outwash Aquifer.
		Bedrock	Weathered Bedrock Aquifer	Uppermost 10 to 50 feet of bedrock.
Upper Talarik Creek Drainage	Upper Talarik Creek (*East WTP Discharge*)	Overburden	Glacial Outwash Aquifer	Outwash sand and gravel upstream of stream gauge UT100E.
		Bedrock	Weathered Bedrock Aquifer	Uppermost 10 to 50 feet of bedrock.
	Talarik Creek Outwash Plain	Overburden	Surficial Aquifer	Glacial deposits, including deltaic, outwash, ice-contact sands, and sand and gravel east of Upper Talarik Creek. Underlain by a low-permeability aquitard.
			Intermediate Aquifer	Extension of aquifer originating in South Fork Koktuli Flats drainage. Located below surficial aquifer and conveys majority of flow from South Fork Koktuli River Aquifer and MW11 Aquifer to Upper Talarik Creek Tributary UT1.190. Discharges to surface upstream of stream gauge UT100B.
		Bedrock	Weathered Bedrock Aquifer	Uppermost 10 to 50 feet of bedrock.

Source: Schlumberger (2011, 2015)

1. Frost-weathered boulders at the surface.
2. Numbered tributaries named for stream gaging stations (See Figure 3.16-3).

The Frying Pan Lake area and the upper reaches of tributary UT1.190 are characterized by thick, silty layers. In contrast, silty layers are absent from the area along the South Fork Koktuli River south of Frying Pan Lake, and overburden consists of sand and gravel. Overburden is relatively thin and permeable beneath most valley floors, with valley walls dominated by colluvium and shallow bedrock, with the exception of some localized thin till deposits. The uppermost portion of the bedrock is typically fractured and able to yield moderate to large quantities of groundwater. Although fractures and faults are widespread in the deeper bedrock, the features are often infilled with fine-grained fault gouge and offset relative to one another. This has created a compartmentalized system of groundwater flow, thereby limiting the flow of regional groundwater through the area.

In the North Fork Koktuli River drainage for tributary NK1.190, overburden is relatively thin on the valley floor, and thicker on the lower slopes of the valley sides. Groundwater recharges on the upper slopes and migrates downslope toward the valley floor, with sustained discharge to numerous seeps at a range of elevations. The calculated average groundwater recharge rate is 11 inches per year. The relatively thin overburden on the valley bottom is inferred to limit groundwater discharge from the catchment, and most of the drainage is inferred to occur via surface discharge to the stream channel. Groundwater recharge in this area is anticipated to be low. Upstream of stream gauge NK1.00C, the headwater catchment for the North Fork Koktuli River is overlain by glacial drift and materials deposited under glacial lakes that have resulted in relatively thin but laterally continuous aquifers. A terminal glacial moraine is near the confluence of the main stem and tributary NK1.190. At this location, the surficial deposits transition to coarser glacial outwash materials that allow the North Fork Koktuli River to exchange water with the underlying aquifer.

In the South Fork Koktuli River drainage near the Pebble Deposit, there is groundwater discharge to the valley floor in relatively low-permeability silty sand and gravel deposits that are approximately 100 feet thick, with the exception of the eastern side of the catchment where a deeper bedrock channel is present. Groundwater gradients are vertically upward with a minimal horizontal component, indicating that groundwater in the vicinity of the Pebble Deposit discharges to the upper reaches of the South Fork Koktuli River near the deposit, and is unlikely to flow across groundwater divides or migrate appreciable distances down the valley. The calculated average groundwater recharge rate is 23 inches per year.

Bedrock near the Pebble Deposit has been extensively investigated. In this area, the uppermost 10 to 50 feet of bedrock is highly fractured and is much more permeable than the underlying bedrock. Deeper bedrock is less weathered and exhibits lower hydraulic conductivity values to depths of at least 500 feet. The groundwater flow system in this area is fed by groundwater recharge, which flows primarily through the overburden and shallow fractured bedrock prior to discharge to the South Fork Koktuli River.

South of the Pebble Deposit, the overburden materials thicken toward Frying Pan Lake. Groundwater elevations in shallow bedrock exhibit stronger seasonal fluctuations than the overlying sand and gravel. Groundwater gradients are upward following periods of groundwater recharge (i.e., snowmelt or rainfall) in the upland areas, and downward during the months prior to seasonal recharge events. This supports the conceptual model of groundwater flow involving recharge to the exposed fractured bedrock aquifer in upland areas, with subsequent migration toward valley bottoms, where the groundwater is eventually discharged to overlying surficial deposits or streams. A bedrock high and the presence of low-permeability sediments at the downstream end of Frying Pan Lake generally limits discharge from Frying Pan Lake to the underlying groundwater flow system. Groundwater gradients near the lake indicate shallow water levels and upward groundwater movement (groundwater discharge) toward the lake, while water levels downstream of the lake are up to 60 feet below the overlying stream, indicating strong downward groundwater gradients and losses from the stream. The results of groundwater level monitoring and a water balance assessment indicate that approximately two-thirds of the groundwater flowing through the aquifer downstream of Frying Pan Lake remains in the South Fork Koktuli River drainage, while the remaining one-third of the groundwater crosses the surface water divide and contributes to groundwater flow in UT1.190, and discharges to Upper Talarik Creek.

In the Upper Talarik Creek drainage, precipitation infiltrates the upper hillslopes and migrates downslope in the highly fractured shallow bedrock unit. The calculated average groundwater recharge rate is 16 inches per year. Where downslope groundwater movement is restricted by low-permeability sediments or discontinuities in the flow system, groundwater discharges to ground surface as springs. Springs are abundant in this drainage, and often occur at locations high on the hillslopes. Overburden deposits are variable in this drainage, and include silty sand and gravel to clean sand in the upper portion of the drainage. In the intermediate reaches of the drainage between UT1.135 and UT1.190, a large area has been filled with deltaic, glacial outwash, ice-contact sands, and sand and gravel. This area is inferred to be a groundwater recharge area. Tributary UT1.190 joins the Upper Talarik Creek drainage downstream of the groundwater recharge area, and is inferred to transmit the majority of groundwater that migrates across the surface water drainage from the South Fork Koktuli River drainage area. Most of the groundwater moves downgradient in the sand and gravel units and the weathered upper bedrock. Steep vertical gradients have been observed in some areas, suggesting the presence of fine sediments that restrict downward movement of groundwater.

Aquifer Properties: Hydraulic Conductivity and Specific Storage

Table 3.17-2 and Figures 3.17-6 through 3.17-8 provide a summary of hydraulic conductivity testing conducted at the Mine Site, based on individual testing results presented in Schlumberger (2015).

Table 3.17-2: Summary of Hydraulic Conductivity Testing Results

Hydrostratigraphic Unit	Statistic	Hydraulic Conductivity (m/s)				
		Pebble Deposit Area	Frying Pan Lake Area	South Fork Koktuli Area	North Fork Koktuli Area	Upper Talarik Area
Overburden	Number of Tests	33	6	45	22	4
	Geometric Mean	2.23×10^{-5}	6.40×10^{-5}	1.00×10^{-4}	9.74×10^{-5}	1.05×10^{-5}
	Median	3.00×10^{-5}	3.25×10^{-4}	4.00×10^{-4}	3.00×10^{-4}	1.45×10^{-5}
	Maximum	1.30×10^{-3}	8.70×10^{-4}	1.00×10^{-3}	1.78×10^{-3}	4.24×10^{-5}
	Minimum	5.10×10^{-8}	6.10×10^{-8}	7.00×10^{-8}	7.80×10^{-9}	1.60×10^{-6}
Bedrock	Number of Tests	52	10	20	50	8
	Geometric Mean	1.78×10^{-5}	4.38×10^{-6}	2.00×10^{-5}	9.68×10^{-7}	1.86×10^{-6}
	Median	1.65×10^{-5}	8.50×10^{-6}	5.00×10^{-5}	9.15×10^{-7}	4.50×10^{-6}
	Maximum	1.40×10^{-3}	9.13×10^{-5}	3.00×10^{-3}	3.00×10^{-4}	2.00×10^{-5}
	Minimum	3.95×10^{-7}	1.60×10^{-8}	1.00×10^{-8}	9.40×10^{-9}	1.73×10^{-7}

Source: Schlumberger (2015: Tables 8.1-1 through 8.1-5).

Figure 3.17-7: Hydraulic Conductivity Measurements in Pebble Deposit Area

Figure 3.17-8: Hydraulic Conductivity Measurements Outside Pebble Deposit Area

Figure 3.17-9: Hydraulic Conductivity Profile for Deep Bedrock

Based on a total of 110 response tests, the hydraulic conductivity of overburden ranges from 7.8×10^{-9} to 1.78×10^{-3} meters per second (m/s) in the Mine Site. The hydraulic conductivity of overburden is similar throughout the Mine Site, with geometric mean values between 1.05×10^{-5} m/s and 1.0x10-4 m/s for each area. Hydraulic conductivity values for overburden materials in the Pebble Deposit and Upper Talarik areas were an order of magnitude lower than those measured in the rest of the Mine Site, based on the median values, likely due to the presence of silty glacial deposits in this area.

Based on a total of 140 response tests, the hydraulic conductivity of bedrock ranges from 9.4×10^{-9} to 3.0×10^{-3} m/s in the Mine Site. Similar to overburden, the hydraulic conductivity of the bedrock is about the same throughout the Mine Site, with geometric mean values between 9.7×10^{-7} and 2.0×10^{-5} m/s. Hydraulic conductivity values for bedrock in the Pebble Deposit and South Fork Koktuli areas are about 1 to 2 orders of magnitude higher than those measured in the North Fork Koktuli and Upper Talarik areas, possibly due to the presence of batholith granodiorite in parts of these areas.

Hydraulic conductivities range across 14 orders of magnitude in nature. Therefore, differences of 1 to 2 orders of magnitude are not considered large, and indicate that the overburden and bedrock are relatively homogeneous overall across the Mine Site.

Larger-scale hydraulic conductivity values were also assessed by conducting a total of nine pumping tests, and found that the hydraulic conductivity of overburden was almost 10 times higher than values derived from response tests (Schlumberger 2011). Pumping rates ranged from approximately 10 to 356 gallons per minute (gpm), and water level responses were observed at significant distances from the pumping well, allowing for a more robust analysis of transmissivity (hydraulic conductivity) and storativity (specific yield) parameters for individual aquifers than possible using response testing and packer testing alone. Detailed analyses and results are presented in Schlumberger (2011: Table 8.1-6). Calculated transmissivity values ranged from 8.0×10^{-5} to 1.1×10^{-1} m/s, indicating the aquifers are capable of conveying moderate to large quantities of groundwater. Calculated storativity values ranged from 1×10^{-5} to 2.5×10^{-2}, which indicates the ability of individual aquifers to store water is moderate to high overall, but is limited for some aquifers. This indicates that response testing underestimates the hydraulic conductivity of the aquifer, which may be due to restrictions placed on pumping associated with the well screen, surrounding sand filter pack, and/or borehole damage during drilling. Pumping test results for wells completed in bedrock were similar to those for response tests.

Hydraulic conductivity values were also measured by conducting borehole packer testing and Lugeon tests as part of geotechnical investigations to depths of up to 4,500 feet near the Pebble Deposit, and at depths of up to 400 feet outside of the deposit area. The highest values were typically measured in the upper 500 feet, but similar values were also measured at considerable depths. Overall, bedrock hydraulic conductivity values are lower at depth than shallow bedrock in the deposit area.

Deep bedrock was investigated through the installation of three Westbay multi-level groundwater monitoring systems (WB-1, WB-3, and WB-4) at three locations to depths of 4,054 feet, 600 feet and 2,250 feet, respectively.

Groundwater Flow Systems

Groundwater level monitoring and interpreted contours revealed the presence of three groundwater divides in the study area (Figure 3.17-6). One divide is between the Upper Talarik Creek drainage and the North Fork Koktuli drainage. A second divide is near the Pebble Deposit between the South Fork Koktuli River drainage and the Upper Talarik Creek drainage. A third divide is between the South Fork Koktuli River drainage and the tributary UT1.190 drainage.

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Although the groundwater divides generally align with surface water drainage divides, there is evidence of some interbasin groundwater exchange from the North Fork Koktuli drainage to the Upper Talarik Creek drainage, and from the South Fork Koktuli drainage to the UT1.190 basin.

Hydrographs for two representative monitoring locations are presented on Figure 3.17-10 and Figure 3.17-11 to illustrate seasonal and vertical groundwater level fluctuations. These examples are in the South Koktuli Flats and Pebble Deposit areas, respectively, and show groundwater levels from three to four different screened intervals over a 9-year period compared to precipitation and stream flow.

The water table typically lies at the greatest depths below upland areas, and is near the surface in valley bottoms. The lowest groundwater levels were typically recorded in late winter immediately prior to spring freshet, while the highest water levels were typically observed during spring freshet or during fall rains, with water levels fluctuating on the order of 10 feet to 20 feet seasonally. Vertical groundwater gradients were found to be variable in both time and with depth, and generally support the conceptual model of compartmentalized groundwater flow. Similar to groundwater levels, measured discharge from seeps varied by a factor of between 3 and 10 seasonally, with a median flow of 44 gpm.

Based on the results of tritium analysis, the majority of the groundwater in Mine Site aquifers likely recharged after 1972, which indicates that groundwater moves through the aquifers relatively quickly. This interpretation is supported by the measurement of relatively high hydraulic conductivities in overburden and shallow bedrock, and the seasonal behavior of groundwater levels in response to rainfall and snowmelt.

Figure 3.17-10: Time Series of Piezometric Elevations at MW-11, South Fork Koktuli Flats Area

Figure 3.17-11: Time Series of Piezometric Elevations at MW-5, Pebble Deposit Area

3.17.1.3 Site Water Balance Model

A site water balance model (WBM) was developed to inform the characterization of site hydrology, understand the nature and extent of groundwater-surface water interactions, and provide estimates of groundwater recharge for use during calibration of the Mine Site groundwater model. A detailed description of the model is provided in Schlumberger (2011: Appendix 8.1I). The model was also used to validate the meteoric data and the variability in precipitation across the site. Continuous streamflow records from a total of 12 gauging stations were used to calibrate the model for the period of time between 2004 and 2008. Sub-catchments were delineated and drainage areas calculated for each gauging station. Inputs to the model and calibration are further described in Section 3.16-Surface Water Resources.

The results of the WBM indicate that groundwater recharge varies from 11 to 23 inches per year for the North Fork Koktuli, Upper Talarik, and South Fork Koktuli drainages. The majority of groundwater that recharges in each catchment tends to discharge to surface within the same drainage, with the exception of the inter-catchment transfer of approximately 6 inches per year that occurs between the South Fork Koktuli River and Upper Talarik Creek drainages. Ongoing efforts are focused on validating and recalibrating the site WBM using data collected since 2008.

[Note: RFI 019 requests WBM predictions based on the proposed mine plan in PLP (2017). Following receipt of RFI response, this section will be updated with data collected since 2012 that may be incorporated into the current model.]

3.17.1.4 Mite Site Grounderwater Model

A numerical groundwater model was developed to simulate baseline groundwater conditions as described in detail in Schlumberger (2011: Appendix 8.1J). The model was calibrated to total recharge and discharge rates obtained from the WBM, described above. The total groundwater recharge and discharge calculated by the WBM includes meteoric recharge and losses from streams to the underlying groundwater flow system. The groundwater model was calibrated to observed groundwater elevations, estimated groundwater recharge, and estimated groundwater discharge obtained from the WBM.

The groundwater model domain encompasses the majority of the Mine Site and sub-catchments that were included in the WBM. The complex site geology was translated into the groundwater model using a five-layer structure, with three layers to represent variably thick overburden units, one layer to represent the uppermost 50 feet of bedrock, and one layer for the underlying bedrock to an elevation of -200 feet mean sea level.

Because groundwater levels and flow exhibit strong seasonality, the model was developed as a transient model with a simulation period of 37 months, from December 2004 to December 2007, to coincide with the WBM. The primary objective was to simulate the behavior of the groundwater flow system in the upper reaches of the South Fork Koktuli River, the upper reach of Talarik Creek, Upper Talarik Creek tributary UT1.190, and the upper reaches of the North Fork Koktuli River. The calibration effort was focused on the South Fork Koktuli River area, where data are most abundant.

The calibrated groundwater model produced water table elevations that follow the same general pattern as field measurements, and also reproduced inter-catchment flows between the South Fork Koktuli River catchment and Upper Talarik Creek catchment UT1.190. A total of 220 piezometers with up to 35 measurements prior to 2008 each was used to calibrate hydraulic heads and calculate hydraulic head residuals to judge the calibration of the model. Focus was placed on calibrating the model to periods of time when the aquifer was stressed during pumping tests.

Simulated groundwater elevations were very similar to measured groundwater elevations, as shown in Schlumberger (2011: Figure 8.1-20), whereby an ideal calibration is represented by equivalent modeled and measured hydraulic heads to produce a straight line. Hydraulic heads in bedrock beneath upland areas are predicted to be slightly lower by the model than measurements. When plotted over time, hydraulic head residuals continually increased in some areas, highlighting opportunities for model refinement; while in other areas, the model produced uniform residuals over the simulation period.

Calculated calibration statistics produced a Root Mean Squared Error (RMSE) of 3 percent, with values ranging between 4 and 12 percent for the focus areas of calibration, suggesting that calibration could be improved in the South Fork Koktuli discharge and tributary UT1.190 areas. RMSE values ranged from 5 to 25 percent for areas in the model domain that were not the focus of calibration. Lower RMSE values generally indicate a good match between the model and actual field data. The largest errors at the Mine Site typically occurred in the bedrock layers. The model was generally able to reproduce measurements of groundwater elevations over time, but was unable to reproduce the range of measured seasonal hydraulic head fluctuations near Frying Pan Lake, where fine sediments may not be adequately reflected in the numerical groundwater model. Although the average direction of vertical flow between overburden and bedrock was well simulated by the model, the seasonality of vertical hydraulic head differences was not well replicated by the model, and will be the focus of the next phase of calibration.

Recharge and discharge rates estimated by the groundwater model agreed fairly well with estimates calculated in the WBM. However, additional refinements are planned for some areas in the South Fork Koktuli River catchment where the WBM and groundwater model were not in agreement. The groundwater model simulates the exchange of water between streams and groundwater, and model estimates were compared with streamflow measurements during periods of time when flows were low, and primarily groundwater-derived. Overall, the groundwater model was able to reproduce measured hydraulic head calibration targets, and was in general agreement with recharge rates, inter-catchment flows, and local groundwater discharge rates estimated by the WBM with a reasonable degree of accuracy.

Schlumberger (2011) indicates that a refined numerical groundwater model is currently being developed to capture geologic information collected since 2008, and to better reflect groundwater-surface water interactions. The model will be calibrated to streamflow during low-flow periods and water levels collected in 2009 and 2010. Overall, there will be an effort to improve the calibration to transient fluctuations in water levels and vertical gradients. The updated modeling will involve a sensitivity analysis, and the predictive ability of the model will be validated using data collected in 2011 and 2012.

[Note: RFI 019 requests groundwater predictions based on the proposed mine plan in PLP (2017). Following receipt of RFI response, this section will be updated with more recent data that may be incorporated into the current model.]

3.17.1.5 Groundwater and Surface Water Interaction

Groundwater and surface water interaction was characterized based on detailed streamflow surveys and the site-wide WBM. The flow surveys were completed during periods of low streamflow, and are described in detail in Knight Piésold (2015). These surveys included eight gauges in the North Fork Koktuli River catchment, 12 gauges in the South Fork Koktuli River catchment, and 12 gauges in the Upper Talarik Creek catchment. Based on the results of the streamflow surveys, gaining and losing stream reaches were identified, and possible explanations for the variability in flows between gauges were provided. The majority of the stream reaches were found to be receiving groundwater discharge from the underlying aquifer (i.e., gaining). However, the North Fork Koktuli River was found to be losing water to the underlying aquifer between gauges NK100B and NK100LF1. The South Fork Koktuli River was found to be losing water to the underlying aquifer(s) from SK100G to SK100F, from SK100F to SK100C, and from SK100B to SK100LF10.

3.17.2 Transportation Corridor and Amakdedori Port

3.17.2.1 Hydrogeological Characterization

The sections below summarize baseline hydrogeological data, where available, across the 84-mile-long Transportation Corridor, spur roads, and Amakdedori Port. The road corridor spans multiple watersheds, from its starting point at the southeastern edge of the Nushagak watershed in the Mine Site, across the greater Kvichak watershed (including Iliamna Lake) to the Aleutian Range watershed divide, and finally entering the greater Cook Inlet watershed east of the divide.

The hydrogeology in the watersheds surrounding the Mine Site is well characterized, as described in Section 3.17.1.2. The northernmost segment of the Transportation Corridor (northern half of the Mine Access Road) is in the well-studied Upper Talarik Creek (UTC) watershed, for which abundant data are available. Limited data are available for the southern segment of the Mine Access Road. No known hydrogeological investigations have been conducted along the South Access Road or Amakdedori Port.

Climatic factors influencing groundwater across the corridor are the same or similar to those described above for the Mine Site. There are no glaciers in the road corridor watersheds. There is no known permafrost in the Transportation Corridor; however, permafrost has been observed in the general area (Detterman and Reed 1973), and may be present at depth in isolated zones, such as on north-facing slopes. Section 3.14-Soils further addresses permafrost.

Hydrostratigraphic Units

The road corridor begins at the Mine Site, which straddles the watershed divide between the SFK and UTC watersheds. The hydrostratigraphic units in the watersheds surrounding the Mine Site are well defined, as described in Section 3.17.1.2. Glacial sands and gravels generally host multiple, very active surficial and intermediate aquifers, while the uppermost 10 to 50 feet of weathered bedrock hosts less active aquifers in most areas (Schlumberger 2015: Appendix 8.1B).The northern half of the Mine Access Road is mostly in the UTC watershed, where groundwater is stored in surficial aquifers of glacial sediment and in fractured shallow bedrock.

The southern half of the Mine Access Road parallels First Creek, a tributary basin that drains southward into the main UTC catchment about 4 miles upgradient of Iliamna Lake. Hydrogeologic data for this southern half of the Mine Access Road are limited. Bedrock and surficial geology along this stretch of the Mine Access Road are similar to the corridor to the north, with Tertiary volcanic bedrock and thick deposits of surficial glacial sediments. Based on the similar geologic setting and topography across the Mine Access Road, it is likely that hydrostratigraphic units are likewise similar here. Permeable sands and gravels, which make up the abundant glacial till and outwash across this stretch of the Mine Access Road, as well as lake terrace and beach deposits within 1 to 2 miles of the North Ferry Terminal (Detterman and Reed 1973), likely host surficial and/or intermediate aquifers. It is possible that weathered bedrock stores additional groundwater at depth.

No known hydrogeological investigations have been conducted south of Iliamna Lake, and hydrostratigraphic units have not been defined for this area. Lake terrace and beach deposits that occur in the South Ferry Terminal area (Detterman and Reed 1973) likely host shallow groundwater. The geologic environment along the rest of the South Access Road and the Kokhanok Airport Spur Road is somewhat distinct from that north of Iliamna Lake. Jurassic age intrusive bedrock is commonly exposed at the surface, and glacial sediments are less abundant. The water table approaches the surface in lowland areas, as evidenced by abundant kettle ponds and wetlands. Glacial deposits are significantly thinner along the South Access Road corridor compared to the Mine Access Road, but likely host shallow aquifers where present (Glass 1999). Shallow groundwater is likely present in surficial alluvium, alluvial fan, marine terrace, and beach deposits near Amakdedori Port (Detterman and Reed 1973). The degree of weathering and fracturing in bedrock is not well known along the South Access Road, and it is unknown if bedrock fractures host significant groundwater. It is also unknown if local fault zones host groundwater, or if they contain fine-grained breccias that may impede groundwater migration.

Aquifer Properties: Hydraulic Conductivity and Specific Storage

The aquifer properties in the northernmost segment of the Transportation Corridor near the Mine Site have been extensively studied, as described in Section 3.17.1.2. The northern half of the Mine Access Road is in the UTC watershed, where groundwater is held in surficial aquifers of glacial sediments and in fractured shallow bedrock. Hydraulic conductivities in surficial aquifers of the upper UTC watershed range from 2x10-6 to 4x10-5 m/s, and hydraulic conductivities in shallow bedrock in this area range from 2x10-7 to 2x10-5 m/s (Schlumberger 2013).

Continuing south, the corridor parallels the First Creek tributary basin, which drains southward into the main UTC basin above Iliamna Lake. No detailed studies have been conducted on aquifer properties here, but a similar geologic setting would suggest that groundwater storage occurs in both surficial sedimentary aquifers and fractured bedrock, as it does farther north. Hydraulic conductivity and storage capacity can vary significantly laterally, but especially in surficial glacial sediment aquifers.

No data on hydraulic conductivity or aquifer storage are available along the Transportation Corridor south of Iliamna Lake.

Groundwater Flow Systems

The groundwater flow systems in the northernmost corridor have been shown to have complex surface water/groundwater interactions (Schlumberger 2013). The UTC drainage basin has both gaining and losing reaches as groundwater migrates generally southeast across the area. Farther south along the Mine Access Road, the water table remains near the ground surface in lowland areas, and groundwater/surface water exchanges likely occur, as has been demonstrated in and around the Mine Site. Existing data and regional groundwater trends suggest a generally southward flow of groundwater along the southern half of the Mine Access Road (Schlumberger 2015: Appendix 8.1B).

There are no known studies on groundwater flow in the Transportation Corridor south of Iliamna Lake. Groundwater flow along the South Access Road corridor likely parallels surficial flow, following general hydrologic trends. In the Kvichak watershed, groundwater is expected to flow northwesterly toward Iliamna Lake. Across the Aleutian Range divide in the Tuxedni-Kamishak watershed, groundwater would likely flow southeasterly towards Kamishak Bay. Near Amakdedori Port, shallow groundwater in surficial deposits and bedrock (where present) likely flows from side hill slopes towards Amakdedori Creek and swamp deposits near the southern end of the road, then parallels creek flow south and southeast towards Kamishak Bay. Groundwater flow beneath beach deposits at the port site may have a diurnal directional component due to large tidal fluctuations.

3.17.3 Pipeline Corridor

No specific studies have been conducted on hydrostratigraphic units, aquifer properties, or groundwater flow systems in the Natural Gas Pipeline Corridor. Data for the hydrogeology of the Pipeline Corridor are the same as those discussed above for the Transportation Corridor, with the exception of the Cook Inlet crossing and the segment of corridor along the Kenai Peninsula. Groundwater beneath Kenai Peninsula is known to occur in multiple aquifers in thick glacial and alluvial deposits above Tertiary sedimentary bedrock (Karlstrom 1964, Nelson and Johnson 1981). Groundwater flow is generally to the west towards Cook Inlet, and seeps commonly occur along Cook Inlet bluff, where fine-grained glacial lake deposits form aquitards and support perched groundwater zones.

[Note: Recent project updates no longer include pipeline construction along the 9-mile stretch south of Happy Valley. This section will be updated in order to describe groundwater characteristics within the revised pipeline corridor.]

3.17.4 Groundwater Use

Most Bristol Bay communities rely on groundwater wells for their drinking water supply, including the nearby communities of Iliamna, Nondalton, and Newhalen (ADEC 2018; ADNR 2018). With the exception of wells in these local communities and exploration wells the Mine Site area, the project area encompasses remote regions with no documented groundwater use. There are no public wells in the Mine Site, and no known wells of any type in the Transportation and Natural Gas Pipeline corridors, or at the Amakdedori Port site (ADNR 2018).

Abundant groundwater wells have been installed by PLP across the Mine Site area for collecting data on aquifer properties, site water balance, and water quality (Schlumberger 2011, 2015). In the project area, groundwater use is currently limited to such sampling and hydrogeologic testing at the PLP wells. PLP has received multiple Temporary Water Use Permits (TWUPs) for exploration activities between 2004 and 2013. The TWUPs give PLP permission to withdraw up to a set number of gallons of water per day, up to a specified annual limit, from specified sources, mostly groundwater wells.

The Applicant's proposed project would include installation of potable groundwater water wells on the northern side of the Mine Site to serve mine site personnel. PLP has tested the groundwater quality at this site, with results showing that minimal water treatment would be required to develop the wells for a drinking water source (PLP 2017).

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3.18 WATER QUALITY AND GEOCHEMISTRY

3.18.1 Surface Water Quality Criteria

On February 27, 2004, the U.S. Environmental Protection Agency (EPA) partially approved revisions to Alaska Water Quality Standards (WQS), while taking no action on Alaska's proposed acute and chronic freshwater aquatic life criteria for mercury and selenium. Therefore, the new aquatic life criteria for mercury and selenium will not be in effect for CWA purposes until a decision is made by EPA about whether these criteria can be approved. In the interim, the previously approved aquatic life criteria for mercury (2.4 micrograms per liter [µg/l] acute and 0.012 µg/l chronic, both as total recoverable) and selenium (20 µg/l acute and 5 µg/l chronic, both as total recoverable) will remain the applicable CWA standards (65 Federal Regulations [FR] 24643).

In instances where the Alaska WQS have been approved by EPA, water quality in this section is described in relation to Alaska WQS, which include use classifications, numeric and narrative water quality criteria, and an anti-degradation policy. The usage classification system designates the beneficial uses that each waterbody within the state of Alaska is expected to support. In Alaska, all waterbodies are designated for all protected water use classes unless otherwise stated (18 Alaska Administrative Code [AAC] 70.050). The water quality data presented in this section are compared to the most stringent applicable State of Alaska water quality standards (for all designated water uses).

For most parameters, the most stringent criteria are the aquatic life criteria for fresh water. However, the most stringent criteria for antimony, arsenic, nitrate, and sulfate are for drinking water (ADEC 2008a; ADEC 2012d). The most stringent criterion for manganese is based on human health for consumption of drinking water and aquatic organisms (ADEC 2008a). The most stringent criteria for boron and cobalt are based on irrigation use (ADEC 2008a).

Criteria for some dissolved metals, including cadmium, chromium, copper, lead, nickel, silver, and zinc, are hardness-dependent, meaning that the acceptable concentrations of these metals depend on the hardness of the water. Hardness is a measure of the concentration of polyvalent cations, such as calcium (Ca2+) and magnesium (Mg2+), in the water. The polyvalent cations that contribute to water hardness reduce the bioavailability of certain trace metals by competing with the trace metal ions for binding sites within organisms. The extent of this effect varies according to which dissolved metals are present, and their oxidation states. To account for the influence of water hardness on the bioavailability and potential toxicity of certain dissolved metals, the numeric water quality criteria for those metals are calculated so that the allowable concentrations of the metals increase in proportion to the hardness of the water (ADEC 2008a). Therefore, the numeric water quality criteria for hardness-dependent parameters vary depending on the measured (or predicted) hardness value for the matrix water.

The Alaska Department of Environmental Conservation (ADEC) numeric water quality standard for ammonia depends on both the temperature and the pH of the matrix water, but not hardness.

3.18.2 Groundwater Quality Criteria

As specified in 18 AAC 70.050(a)(2), groundwater is protected for all uses in Class (1)(A), including drinking, culinary, and food processing; agriculture, including irrigation and stock watering; aquaculture; and industrial uses. Although ADEC does not regulate groundwater directly, they do regulate contaminated sites and underground storage tanks that may affect groundwater quality, and establish WQS that serve to protect groundwater.

Drinking water from groundwater sources is regulated by 18 AAC 80 (ADEC 2012c) and by EPA (2013k, 2017c). EPA sets standards for approximately 90 contaminants in drinking water. These standards include National Primary Drinking Water Regulations, which set legally enforceable Maximum Contaminant Levels (MCLs) that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. Secondary Drinking Water Standards are unenforceable federal guidelines regarding taste, odor, color, and certain other effects of drinking water. EPA MCLs for certain constituents (e.g., aluminum, chloride, iron, manganese, pH, sulfate, total dissolved solids [TDS], and zinc) are Secondary Drinking Water Regulations that set non-mandatory water quality standards. EPA recommends them to the states as reasonable goals, but federal law does not require compliance with them.

3.18.3 Sediment Quality Criteria

There are no regulations established for chemical concentrations in sediment. Sediment Quality Guidelines (SQGs) recommended by ADEC (2013d), as well as other sediment quality criteria used for comparison purposes in project studies, are discussed below, and focus on the Mine Site.

The sections regarding sediment quality address existing baseline characteristics of the substrate in ponds, lakes, rivers, streams, and the seafloor within the project area, where documented. See Section 3.22, Wetlands/Special Aquatic Sites and Waterbodies, for a discussion of wetlands substrate.

Waterbody substrates are included under "waters of the U.S." as defined in the Clean Water Act (CWA), and therefore are protected under CWA 404(b)(1); Subpart C, 230.20, Substrate. A determination of potential project impacts on waterbody substrates is addressed in Environmental Consequences Section 4.18., Water Quality, and Section 4.22, Wetlands/ Special Aquatic Sites and Waterbodies. Those sections include information on tailings and dredge spoils storage, as pertinent to CWA 404(b)(1).

Waterbody substrate data are limited within the project area. Baseline physical and chemical data on substrate/sediment from the major drainages and other waterbodies in the project area, including wetlands, were collected between 2004 and 2008 (Knight Piésold 2011; SLR Alaska 2011; R2 et al. 2011; HDR Alaska 2011; SLR Alaska et al. 2011; Three Parameters Plus and HDR 2011). The National Uranium Resource Evaluation (NURE) program collected a variety of substrate samples across the region in 1977 (Grossman 1998). NURE data include very basic physical substrate descriptions and thorough chemical analyses, as well as reporting of potential contaminant sources, and are included below.

3.18.4 Mine Site Area

The Mine Site would consist of an open pit; waste rock stockpiles; tailings storage facility (TSF); low-grade ore (LGO) stockpile; the mill and concentration facilities; and warehouses, offices, and housing. Of these Mine Site components, the open pit, LGO and waste rock stockpiles, and tailings pose the most significant risk to water quality because they expose fresh rock to oxidation and leaching processes that may generate acidic drainage and leach metals. ADNR (2014) states in their Overview of the Process for Large Mine Permitting in Alaska that "rock chemistry drives water quality and mine design."

Figure 3.18-1 depicts the mine site analysis area and extent of current surface water quality data.

Figure 3.18-1: Locations of Water Quality Data

[Note: RFI in preparation for GIS data to prepare comprehensive figure with all surface water quality data locations] Figure will be based on EBD Figures 9.0-2 through Figure 9.0-6 from EBD, Chapter 9.

The Pebble Deposit is a copper-gold-molybdenum porphyry deposit. The deposit formed about 90 million years ago, when older sedimentary and igneous rocks were intruded by a granitic magma laden with hot fluids carrying dissolved copper, gold, molybdenum, and silver, as well as quantities of rhenium and palladium. As the fluids cooled, concentrations of sulfide minerals, chalcopyrite (CuFeS¬2), molybdenite (MoS2), and pyrite (FeS2), hosting the copper, molybdenum, gold, and silver metals, precipitated in quartz veins and disseminated throughout the granitic and adjacent sedimentary and igneous rocks.

3.18.4.1 Geochemical Processes

In the natural environment, rocks are broken down into soil through exposure to air and water in a process called weathering. During weathering, minerals comprising the rocks react with air (oxidation) and water (dissolving into solution) to release some of their constituents (ions) into the surrounding environment. In many cases, the primary (original) minerals are transformed into secondary minerals during this process. The ions that go into solution may be transported away by overland runoff, streams, and groundwater. Therefore, weathering has a large influence on water quality. If a mineralized deposit is buried beneath other rocks, sediment, and soil, it naturally weathers very slowly. However, when a mineralized deposit is excavated during mining, the weathering process can increase substantially because previously unexposed rocks are broken up and exposed to rain, snow, and air at the surface.

Both ore and non-ore rocks contain minerals (typically pyrite, FeS2) that can produce acid during weathering. The sulfur in pyrite reacts with oxygen and water to form sulfuric acid (H2SO4) through the reaction: FeS2 +15/4 O2 +7/2 H2O = 2H2SO4 + Fe(OH)3. The resulting acidic water is known as acid rock drainage (ARD), which accelerates the weathering process. Metals and other potentially harmful constituents can also be released during weathering in a process called metal leaching (ML). Most metals are released more rapidly in acidic water. However, some other constituents, including metalloids such as arsenic, molybdenum, and selenium, and salts such as sulfate, can be released into the environment even if the water draining the rock has a neutral or basic pH (Smith 2007). The rate of acid generation is counteracted by minerals that neutralize the acid (such as calcite, CaCO3). The neutralization is generated through a reaction of calcite with the sulfuric acid: CaCO3 + H2SO4 = Ca2+ + SO42- + H2O + CO2. Acidification is typically delayed until the neutralizing minerals are exhausted.

The task of geochemical characterization at the proposed Mine Site is to identify the potential of the rocks in and surrounding the mineralized deposit to produce ARD and/or ML that could affect water quality in surface water and/or groundwater. The characterization process involves studies of the mineralogy of the rocks, the quantities of minerals with potential to generate or neutralize acid, the amounts of leachable constituents in the rocks, and the rates of weathering and release of these minerals and constituents expected during mining, and after mining ceases. Geochemical characterization was undertaken as part of environmental baseline studies over a number of years to evaluate the potential for ARD and/or ML for the Pebble Project. A brief summary of the results of these studies follows. Geochemical results described below are largely sourced from Chapter 11 Geochemical Characterization, Bristol Bay Drainages, of the Pebble Mine Environmental Baseline Document (SRK 2011).

3.18.4.2 Geochemical Characterization

The objectives of the geochemical characterization program were to predict the weathering and leaching behavior of rock, tailings, and other materials that would be produced during mining and processing. The data produced from geochemical testing are used to predict the chemistry of waters that contact the rock exposed in the open pit, stockpiled as LGO to be used later, or disposed as waste rock and tailings, and determine their ARD/ML potential.

Samples for geochemical testing were selected from the numerous exploration cores drilled to outline the deposit. The samples included all the main Pebble Deposit rock types, and adjacent rock types that might be removed during mining. As of 2012, the program had included analysis of over 1,000 rock samples from the Pebble Deposit, and 26 samples of overburden materials. In addition, almost 60 tailings samples from test processing of ore composites have also been characterized (49 samples plus various quality control samples). To date, limited testing has been performed on the representative concentrate, because possible designs for a metallurgical process are still at an investigative stage.

The rock samples were tested for mineral abundance using transmitted and reflected light microscopy, and ARD potential, bulk chemical composition, and constituent mobility. Geochemical tests have included acid-base accounting (ABA), sequential net acid generation, shake flask extractions, meteoric water mobility, humidity cells, subaqueous (saturated) leach columns, and on-site field weathering (barrel and bag) tests to evaluate rates of oxidation, acid generation, acid neutralization, and element leaching.

In some mineralized deposits, rock type alone can be a good indicator of whether a rock will potentially produce ARD and/or ML. There are two main geological divisions at the proposed mine site. The mineralization is hosted by sedimentary and volcanic rocks of pre-Tertiary age. After the pre-Tertiary occurrence of mineralization, those rocks were partially eroded, then covered by other sedimentary and volcanic rock later in the Tertiary period. The later-Tertiary-age rocks at the Mine Site generally do not contain copper, gold, or other metals in formats that would be economically viable to recover at the present time.

ABA has determined that the pre-Tertiary mineralized rocks at the proposed mine site are predominantly Potentially Acid Generating (PAG). The acid-generating potential (AP) in these rocks is relatively high, as indicated by the total sulfur content of greater than 1percent, and the neutralization potential (NP) of these rocks is limited. In contrast, the majority of the Tertiary-age rocks that comprise the cover and overburden materials at the proposed mine site have sulfur concentrations of less than 0.1percent, which indicates low AP. The cover and overburden rocks also contain significant NP. As a result of the low AP and high NP in the cover and overburden, these materials are generally considered Non-potentially Acid Generating (NAG).

Most of the older pre-Tertiary sedimentary and igneous rocks hosting the Pebble Deposit were found to be PAG. The acid potential is largely derived from oxidation of pyrite and characterized by more than 1 percent sulfur content. The NP of the pre-Tertiary rock is limited. The majority of the younger Tertiary rocks and glacial overburden materials have low sulfur content (less than 0.1 percent) and significant NP. These materials are typically classified NAG.

To develop an understanding of weathering and leaching processes that might affect rocks exposed during mining (e.g., pit walls, stockpiled materials, and waste rock), additional laboratory and field geochemical tests were conducted. Laboratory tests included humidity cell tests and saturated columns. Humidity cell test data allow interpretation of long-term acid generation potential and neutralization rates. Humidity cell tests also confirm ABA criteria for segregating PAG from NAG rocks and waste, based on the NP to AP ratio. The NP/AP ratio that distinguishes PAG and NAG is 1.6, and is applicable to pre-Tertiary, Tertiary, and overburden materials.

The humidity cell tests also help to estimate the potential lag or delay in the onset of ARD. The delay occurs because acid-neutralizing minerals (e.g., calcite, feldspars, and micas) are not depleted instantly as acid is formed, but are consumed at different rates depending on their reactivity and abundance. Results show that rocks with low NP/AP ratios (less than 0.1) have little neutralization potential and are likely to generate acid within a few years. Rocks with NP/AP ratios of 1 have higher neutralization potential, which delays the onset of acid generation to more than 20 years. Paste pH results for aged rock cores stored at the site suggest that acidification maybe delayed up to 40 years. Given differences in the test conditions, laboratory and field test suggest that oxidized pre-Tertiary mineralized rock may take up to several decades for acidification to occur.

Element release rates indicated by kinetic tests were mainly a function of leachate pH rather than the element content of the samples. Leaching of copper accelerated as pH decreased; therefore, the potential for metal release is linked to the potential for acid generation, and ABA data can be used to assess the potential for copper leaching. However, for some elements (e.g., arsenic, molybdenum, and selenium), release is significant under neutral pH conditions. Tests on some samples of Tertiary rock showed relatively elevated leaching of these elements under non-acidic conditions.

Ore processing based on a conventional flotation process to recover chalcopyrite and molybdenite, the primary copper and molybdenum minerals, followed by treatment of pyrite to recover gold, will result in a low sulfide bulk tailing concentrate and a high-sulfide (pyrite-rich) tailing concentrate, respectively. Low sulfide tailings are expected to have low potential to generate ARD, provided the sulfide mineral content is less than about 0.2 percent. Element leaching from the low sulfide tailings occurred at low rates, and process supernatants were found to contain low levels of potential constituents relative to water quality standards. The pyrite concentrate tails are expected to be PAG, and are likely to leach metals at higher concentrations.

Because of the geochemical variability in the rocks, assessment of impacts resulting from geochemical processes requires consideration of the disposition and fate of the material that would be mined each year. The annual area mined can be estimated by developing a block model. (The block model is a computer model that shows the three-dimensional location of each type of rock and the likely order of mining.) Rock material is assessed based on whether the material would take a long time to react – developing acid or losing neutralizing potential – and whether the material would be processed to end up in tailings or set aside as waste rock, in order to design waste management strategies.

Based on the results obtained from integrating the geochemical studies with the block model, the majority of the rocks that would be mined from the deposit do not have the potential for acid generation, and could be considered substantially acid neutralizing. However, some rocks do have the potential to leach certain constituents; mainly, arsenic and sulfate. These results, and their influence on the existing baseline water quality at the site of the proposed mine, will be discussed in more detail in the next few sections.

3.18.4.3 Surface Water Quality

The Pebble Deposit is located in the headwaters of the Upper Talarik Creek (UTC) drainage and the South Fork Koktuli (SFK) River drainage, and adjacent to the headwaters of the North Fork Koktuli (NFK) River drainage. The NFK River drainage is immediately north of the project area. The Kasanak Creek (KC) drainage lies south of the SFK River drainage.

A water quality study was conducted to quantify chemical and physical parameters that describe the quality of the water in the Mine Site, and other areas that would potentially be impacted by the proposed action and alternatives. Water quality data were collected for rivers, lakes, and seeps in the project area, and throughout a 965-square-mile area that includes the NFK River, the SFK River, and UTC.

A comprehensive network of sampling stations was established in the project area for sampling surface water from streams, lakes, and seeps. Stream samples were collected from 44 locations during 50 sampling events from April 2004 through December 2008. Lake and pond samples were collected from 19 lakes once or twice per year during 2006 and 2007. Seep samples were collected from 11 to 127 sample locations, depending on the year, two to five times per year.

Altogether, between 2004 and 2008, over 1,000 samples were collected from streams, more than 600 samples from seeps, and approximately 50 samples from lakes. Additional samples were also collected during the supplementary water quality study period, which occurred from 2008 and 2013.

Results of analyses of samples collected from surface water resources in the project area indicate that the baseline surface water resources can generally be characterized as cool, clear waters with near-neutral pH that were well oxygenated, low in alkalinity, and generally low in nutrients and other trace elements. Water types ranged from calcium-magnesium-sodium-bicarbonate to calcium-magnesium-sodium-sulfate. Water quality occasionally exceeded the maximum criteria for concentrations of various trace elements. Additionally, cyanide was occasionally present in detectable concentrations, and there were consistently detectable concentrations of dissolved organic carbon. Concentrations of petroleum hydrocarbons, polychlorinated biphenyls (PCBs), and pesticides were all below the applicable limits of detection (LODs) for the analyses.

Some differences in water quality between watersheds and some trends in water quality along streams were noted. Sulfate, copper, zinc, nickel, and molybdenum concentrations were greatest in the SFK, consistent with the headwaters of this river passing through the deposit area, and multiple sample locations present in this area. Significantly higher concentrations of copper, molybdenum, nickel, zinc, and sulfate were present in the SFK than in the NFK, consistent with the SFK's proximity to the deposit area. Total dissolved solids (TDS), pH, sodium, alkalinity, hardness, nitrogen (total nitrate+nitrite), and nickel concentrations were greatest in the UTC drainage. The uppermost reach of UTC passes through a portion of the general deposit area, and also had significantly higher concentrations of all of these naturally occurring constituents, except copper, than in the NFK. Total suspended solids (TSS), potassium, chloride, iron, and arsenic concentrations were highest in KC, while cadmium and lead concentrations were highest in the NFK drainage. These characteristics of KC and NFK likely indicate that these parameters are unrelated to the deposit area, and represent water quality signatures that are distinct from the other drainage areas. The following paragraphs discuss some of the specifics of the sample results and trends.

The mean levels for TDS in streams, by watershed, ranged from 37 to 51 milligrams per liter (mg/L), which is 10 percent or less of the most stringent ADEC water quality maximum criterion. Of the three streams that originate close to the deposit area, the UTC and SFK had significantly higher TDS levels than the NFK. Furthermore, a decrease in the TDS levels with distance along the stream was more pronounced in the SFK and UTC watersheds than in the NFK watershed.

Higher TDS in the UTC and SFK watersheds with decreasing trends downstream were expected, because the deposit area lies within their watersheds, and the oxidation of sulfide minerals associated with the deposit would release dissolved solids. The mean levels for TDS in lakes and seeps were similar to those for streams, with values of 49 and 42 mg/L, respectively.

The highest value for TSS was in KC, and the lowest was in the NFK. The mean for TSS in lakes and seeps was similar to that for streams.

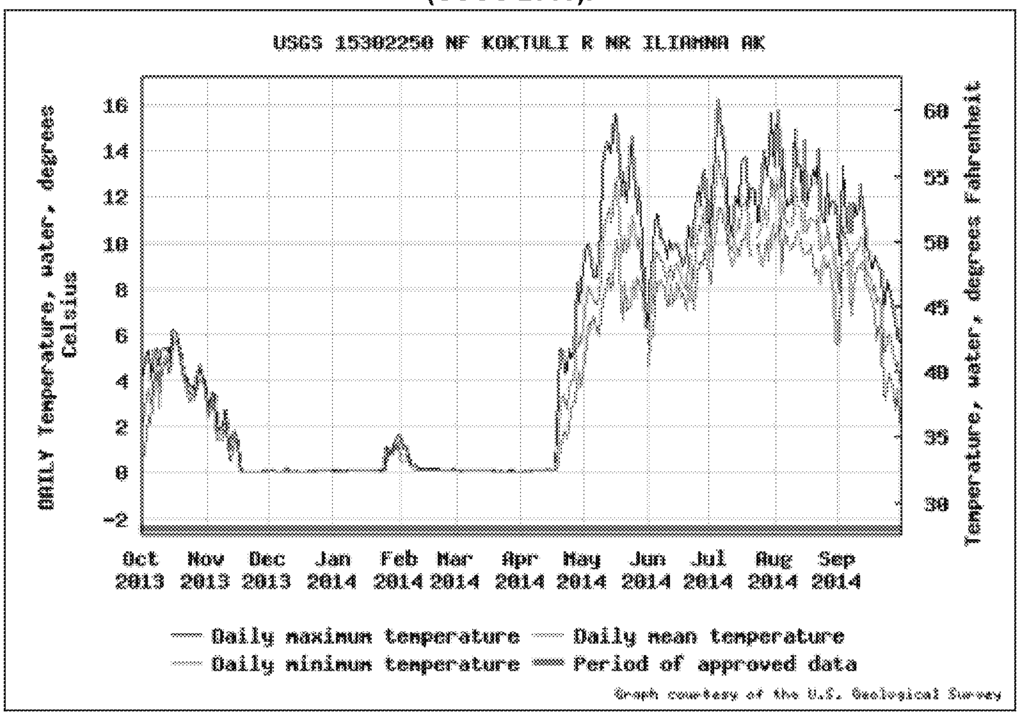
The pH values in surface water were close to neutral. The mean pH for streams, by watershed, ranged from 6.7 to 7.0. Therefore, even though the oxidation of sulfide minerals was expected to be releasing acid in the deposit area, carbonate minerals appear to provide effective pH buffering. The mean pH values for lakes and seeps were 7.2 and 6.5, respectively. Although the mean pH values fell within the range for pH specified in the most stringent ADEC criterion, 34 percent of all individual water quality samples did not meet the water quality criteria for pH. The frequency of this trend in seeps was at least double that of streams, depending on the watershed.

The alkalinity of the surface water samples was low. The mean alkalinity for streams, by watershed, ranged from 17 to 32 mg/L. The mean alkalinity for lakes and seeps was 19 and 23 mg/L, respectively. Alkalinity was the parameter that was most frequently detected outside the range of the most stringent ADEC criterion. In all, 43 percent of all surface water samples were below the most stringent ADEC minimum criterion for alkalinity. The frequency with which alkalinity values for lakes and seeps were below the minimum criterion was 10 to 20 percent higher than the frequency for streams.

Temperature

The mean water temperature in streams ranged from 4.0 to 4.8 degrees Celsius (°C), depending on the watershed. The coefficient of variation was close to 1 for each watershed. In other words, the standard deviation of the temperature values measured in each watershed was approximately equal to the mean of the values, indicating a high level of variability.

Figure 3.18-2: Daily water temperatures in the NFK at 59°50'35.4"N, 155°42'58.9"W, 3.5 miles upstream from the mouth, and 28.5 miles northwest of Iliamna. The temperature record shows the pattern in water temperatures over the period of 1 year from October 2013 to September 2014. (USGS 2018).



[Note: Figure 3.18-2 will be prepared as .pdf]

The lakes were considerably warmer, with a mean temperature of 12°C, and the seeps were slightly cooler, with a mean temperature of 3.4°C.

Dissolved Oxygen

Dissolved oxygen (DO) concentrations in streams were very similar in all watersheds, with mean concentrations that ranged from 10.2 to 10.5 mg/L. These values are close to the theoretical solubility of oxygen of 12.3 mg/L at 900 feet amsl, and a water temperature of 4°C. Although most samples indicated high DO, 7 percent of the samples had DO concentrations lower than the most stringent ADEC minimum criterion.

Major Ions

The water type of most samples from the streams ranged from calcium-magnesium-sodium-bicarbonate to calcium-magnesium-sodium-bicarbonate-sulfate. The cation composition was dominated by calcium and was relatively consistent. The anion composition had a wider range, with most stream samples being dominated by carbonate. The average water type of the lakes and seeps was generally the same as the streams; however, the seeps had a slightly greater range of water types, and the distribution of water types was slightly different. Specifically, the seeps included samples with a higher proportion of sulfate, and the samples also were distributed more evenly across the spectrum of anion composition, rather than being weighted toward the bicarbonate end of the spectrum.

Nutrients

Nutrients, which included total ammonia, nitrate+nitrite, total phosphorous, and orthophosphate, had generally low concentrations, especially in lakes and seeps. Orthophosphate was generally not present at detectable levels, with one exception in the KC watershed. Total ammonia was detected in 19 to 36 percent of all surface water samples, and mean concentrations ranged from 0.03 to 0.05 mg/L, depending on whether the samples were from streams, lakes, or seeps. Nitrate+nitrite and phosphorous were detected in 66 to 98 percent of all surface water samples. Mean concentrations of nitrate+nitrite ranged from 0.1 to 0.3 mg/L, and mean concentrations of total phosphorous ranged from 0.02 to 0.04 mg/L. None of the nutrient concentrations exceeded the most stringent ADEC maximum criterion. The coefficients of variation for nutrients were high compared to most other parameters, often in the range of 1 to 2.

Trace Elements

The trace elements aluminum, antimony, arsenic, barium, cadmium, copper, iron, lead, manganese, molybdenum, mercury, nickel, and zinc were detected in surface water, although at low concentrations. The frequency of detection depended on the watershed, and on whether the sample was collected from a stream, a lake, or a seep. Total and dissolved aluminum, barium, copper, iron, manganese, and molybdenum were typically the most frequently detected trace elements in the streams and lakes; the frequency of detection generally ranged from 85 to 100 percent. The most frequently detected elements in the seeps were generally the same as those for the streams and lakes, but the frequency of detection was lower in the seeps (53 to 99 percent, rather than 85 to 100 percent). Exceptions to this general pattern included a frequency of detection for total and dissolved arsenic in KC of more than 98 percent.

The trace elements arsenic, lead, nickel, and zinc had an intermediate frequency of detection, with the exception of zinc, which had a higher frequency of detection (98 percent) in lakes.

Cadmium had the lowest frequency of detection. Some trace element concentrations in stream samples exceeded the most stringent ADEC maximum criteria. Copper from the SFK watershed exceeded the water quality criterion most frequently, with total copper exceeding the criterion in 42 percent of samples, and dissolved copper exceeding the criterion in 34 percent of samples. In contrast, copper had one of the lowest frequencies of exceedance in other watersheds. The relatively high frequency of exceedance in the SFK watershed is probably related to the proximity of the deposit. Total aluminum exceeded the most stringent ADEC maximum criterion in 12 to 22 percent of the stream samples from the SFK, UTC, and KC watersheds; and in 6 percent of the samples from the NFK watershed. In contrast, dissolved aluminum exceeded the criterion in only 1 percent of the stream samples, and only in the UTC watershed; therefore, aluminum exceedances seem to be almost exclusively associated with suspended solids. Total lead exceeded the most stringent criterion in 8 to 16 percent of the stream samples, and was generally the next most frequently exceeded criterion after total aluminum. Dissolved lead exceeded the criterion in 1 to 6 percent of the stream samples, and was second only to copper for frequency of exceedance for dissolved elements. Total manganese exceeded the criterion in 15 percent of the stream samples from the SFK and UTC watersheds, in 3 percent of the samples from the NFK watershed, and in none of the samples from the KC watershed. Similar to aluminum, manganese exceedances appear to be associated with suspended solids.

Concentrations of total antimony, cadmium, iron, mercury, and zinc for the stream samples rarely exceeded the criteria (0.3 to 4 percent).

In samples from lakes and seeps, exceedances of the most stringent maximum criteria included total and dissolved aluminum, total and dissolved copper, total and dissolved iron, total and dissolved nickel, total and dissolved lead, total and dissolved cadmium, and dissolved manganese.

Cyanide was occasionally detected in the surface water samples. Total cyanide was detected in 2 to 15 percent of all samples, and weak acid dissociable cyanide was detected in 5 to 13 percent of all samples, depending on whether the samples were collected from streams, lakes, or seeps. Concentrations of weak acid dissociable cyanide in samples were compared with the most stringent ADEC maximum criterion, and exceeded this criterion in 1 to 3 percent of the stream samples, depending on the watershed.

Dissolved organic carbon was detected in 93 to 100 percent of the stream samples, and the mean concentrations ranged from 1 to 2 mg/L, depending on the watershed.

Concentrations of petroleum hydrocarbons, volatile and semi-volatile organic compounds, polychlorinated biphenyls, and pesticides were not detectable above the method reporting limit.

3.18.4.4 Groundwater Quality

Thirty-nine groundwater monitor wells with depths up to 200 feet below ground surface were installed in the project area (Note: Information to be updated based on Supplemental EBD). One deep drill hole (DH-8417) was used for sampling at depths ranging from 640 to 4,050 feet. The results for groundwater are discussed here as median values for individual wells. Most groundwater samples from depths of 200 feet or less were typically characterized by median levels of TDS less than 100 mg/L (comparable to surface water), median pH values between 5.8 and 7.4, median DO concentrations greater than 8 mg/L, and concentrations of trace elements below the most stringent ADEC water quality maximum criteria. Concentrations of TDS in groundwater generally decreased with distance from the deposit area. Monitor well MW-14D in the SFK watershed was the only well with a relatively high TDS level that was not consistent with this general pattern. Most of the groundwater samples had a composition that ranged from calcium-bicarbonate to calcium-magnesium-bicarbonate to calcium-sodium-bicarbonate. Some samples from relatively close to the deposit area had a higher proportion of sulfate, suggesting that the groundwater in this area is influenced by oxidation of the sulfide minerals that are associated with the deposit. As the sulfide minerals oxidize, iron, sulfate acid, and probably trace elements are released. The acid is neutralized by carbonate minerals such as calcite and dolomite, which release calcium, magnesium, manganese, carbonate, and usually some trace elements. This series of geochemical reactions increases the concentration of TDS and the proportion of sulfate in the groundwater.

Although sulfides appear to be oxidizing in the deposit area, the groundwater is not acidic. The lowest median pH values were 4.9 and 5.3. All other median pH values were greater than 5.8. Eight of the wells (six completed in overburden, two in bedrock) had median pH values greater than 7.0, and three of these wells (all completed in overburden) had the highest median TDS concentrations.

The DO measured in the groundwater was usually quite high. Twenty-seven of the 39 wells had median DO concentrations of 8 mg/L or greater.

The wells with relatively high TDS also generally had relatively high concentrations of arsenic, barium, and molybdenum compared with other wells in the analysis area. All of the wells with more than two trace metals at relatively high concentrations were located closer to the deposit area.

Some systematic differences in concentrations were observed with depth, as indicated by the differences in concentration between wells that were completed in overburden and those that were completed in bedrock. Specifically, the concentrations of antimony, arsenic, copper, iron, manganese, and molybdenum tended to be higher in wells in bedrock than in wells in overburden. Conversely, the concentrations of DO and nickel tended to be lower in wells in bedrock than in wells in overburden.

3.18.4.5 Sediment Quality

Physical Substrate and Sediment Description

Waterbody substrate data coverage within the Mine Site includes the SFK, the NFK, and UTC. Streambed sediment from these drainages is dominated by medium to coarse gravels to small cobbles, with boulders present in stretches of rapids. In areas of low water velocity and pools, sands and silts are more common, and organic sediments are present in some areas (Knight Piésold 2011; R2 et al. 2011). The NURE program collected a variety of substrate samples across the region in 1977 (Grossman 1998). NURE data include basic physical substrate descriptions and thorough chemical analyses, as well as reporting evidence for potential local contaminant sources. Twelve samples of pond substrate collected by NURE within approximately 20 miles of the Mine Site were all reported as mud/fine sediment (Grossman 1998). Limited data from the shores of Frying Pan Lake show a sand, silt, and gravel substrate (R2 et al. 2011).

Chemical Substrate and Sediment Quality

Between 2004 and 2007, 198 samples of sediment from lakes, ponds, seeps, and major and minor drainages in the analysis area were sampled and analyzed for their content of naturally occurring trace elements, anions, and cations (SLR Alaska 2011). Of the 26 trace elements for which samples were analyzed, all were present above detection limits in at least some of the samples, with aluminum, iron, calcium, and magnesium present at substantially higher concentrations than the other elements. Mercury content of sediment samples was the lowest level detected, at a mean concentration of 0.040 milligrams per kilogram (mg/kg). Comparing sediment from the major drainages, copper was the only element showing significant variation, likely due to the difference in rock composition across the drainages. Copper concentrations were particularly high in substrate of the SFK, likely due to copper-rich bedrock at the headwaters. Sediments from ponds and minor drainages in the Mine Site area showed higher concentrations of anions and cations such as sulfate, ammonia, and sodium than did other waterbodies. Total cyanide concentrations were the lowest of the analyzed anions on average, with a mean concentration of 0.39 mg/kg (SLR Alaska 2011). Of the 12 pond substrate samples analyzed by the NURE within 20 miles of the Mine Site area, none showed evidence of contamination (Grossman 1998).

3.18.5 Amakdedori Port

The port site is just north of the mouth of Amakdedori Creek on the western shore of Cook Inlet. The Cook Inlet basin is an expansive watershed surrounding the 180-mile-long Cook Inlet waterbody. Covering more than 38,000 square miles of southern Alaska, it receives water from six major watersheds and many smaller ones. More than 10 percent of the basin is covered by glaciers, and suspended sediment loading in glacier-fed rivers without lakes is significant, leading to a high suspended sediment load in portions of Cook Inlet.

Lower Cook Inlet is connected to the Pacific Ocean southwest through Shelikof Strait, and southeast by the Gulf of Alaska, and demonstrates complex circulation patterns. The region has the fourth largest tidal range in the world; tidal fluctuations in Kamishak Bay average 13 feet. When the tide drops from mean high to mean low water, the inlet loses almost 10 percent of its volume, and exposes approximately 8 percent of its surface area. Most of these tidally exposed areas are in the arms, at the north end of Cook Inlet and along the west side of the waterbody.

3.18.5.1 Surface Water Quality

The area surrounding Cook Inlet is the most populated and industrialized region of Alaska. Therefore, its waters are influenced by urban (and a small amount of agricultural) runoff, oil and gas activities (accidental spills, discharges of drilling muds and cuttings, production waters, and deck drainage), effluent from municipal wastewater treatment facilities, oil and other chemical spills, offal from seafood processing, and other regulated discharges (NMFS 2016).

Water quality in the Iliamna/Iniskin Estuary during the period from 2004 through 2008 appeared to be dominated by tidal exchange with Cook Inlet and Kamishak Bay, with smaller, localized effects from freshwater inputs and local wind waves. Observed gradients in salinity between the inner (lower salinity) and outer (higher salinity) portions of Iliamna Bay are consistent with this conclusion. Average salinity was observed to decrease from the outer stations of Iliamna Bay to the inner stations. This is likely a result of freshwater inputs at the head of Iliamna Bay. Salinity decreases from spring to late summer, and increases again in the fall, thereby providing an additional indicator of the influence of regional water on the bays. A certain amount of stratification was observed during both the spring snowmelt season and during the warmer summer months, particularly during calmer weather and in more sheltered portions of the bays.

Snowmelt or significant rain events create a freshwater surface lens a few centimeters deep in areas adjacent to freshwater inputs; these lenses rapidly diminish as a result of tidal and wind driven mixing.

Analysis of available data indicates that turbidity is generally moderate, and does not exhibit any obvious trends that indicate point-source inputs. On a monthly basis, average turbidity remained relatively constant over the analysis period, generally ranging between 3.1 and 13.0 Nephelometric Turbidity Units.

Analyses of hydrocarbon concentrations in marine water from the Iliamna/Iniskin Estuary in 2004, and of metal and trace element concentrations in 2008, showed little to no connection to anthropogenic effects. Concentrations of all inorganic constituents were less than water quality maximum criteria recommended by the EPA and others for marine habitat, many by orders of magnitude. Organic constituents were similarly at low levels, and appeared to be derived from biologic, petrogenic, and anthropogenic sources.

The data provide some support for a relationship between increased concentrations of inorganic constituents and TSS, but demonstrate no strong patterns with respect to depth in the water column, to geography, or to tidal elevation.

Data analyses show the marine waters of the Iliamna/Iniskin Estuary to be high-quality habitat for marine biota. For example, waters free from toxins or other agents of a type or amount harmful to Cook Inlet beluga whales are considered a principal component of the Cook Inlet beluga whale critical habitat in the Amakdedori Port area. The National Marine Fisheries Service (NMFS; 2016) discussed that the comparatively low levels of contaminants documented in Cook Inlet belugas, as well as in chemical analyses of water and dredged sediments, suggest that the relative concern of known and tested contaminants to Cook Inlet belugas is most likely low.

3.18.5.2 Groundwater Quality

A large aquifer system is found beneath much of the Cook Inlet region, including the Amakdedori Port area. Groundwater also occurs in saturated fractures in the bedrock, and provides most of the water in streams near the port area during winter (Glass 1999). Aquifers are primarily situated within glacial till, glacial outwash, and fluvial deposits overlying sedimentary and low-grade metamorphic bedrock. Glacial deposit aquifers have been described as “irregular in distribution and highly variable both in composition and in their ability to provide water to wells” (Brabets 1999).

3.18.5.3 Sediment Quality

Physical Substrate and Sediment Description

Amakdedori Port would be constructed on the southwestern shore of Lower Cook Inlet, on Kamishak Bay. Significant dredging of shallow offshore sediments would be required for construction of a marine vessel channel (estimated initial dredge volume of 10,000,000 cubic yards), and maintenance dredging of the channel would continue throughout two decades of production at the mine (PLP 2017). Placement of dredged sediments is subject to CWA (404)(b)(1), and is addressed in Section 4.18.X.

No known offshore sediment sampling has been conducted to date at the port site. Sediment samples from the estuarine environments of Iliamna and Iniskin bays, about 30 miles northeast of the port site, revealed substrates of fine sediment (SLR Alaska et al. 2011). Offshore sediments at the port site would likely be more coarse-grained than the estuarine substrate, because of the strong current and tidal influences of the open water environment, which tend to keep fine sediments in suspension. Geophysical surveys and sediment sampling in Kamishak Bay are scheduled for the 2018 field season to characterize dredge spoils that would be generated from development of the port site (PLP 2018). This section will be updated as new data are received.

Studies from other sites within Upper and Lower Cook Inlet have provided a general characterization of seafloor substrate and sediment properties. Lower Cook Inlet is a tidal embayment with a substrate of abundant glacial sediments, predominantly cobbles, pebbles and sand, with minor amounts of silt and clay (Sharma and Burrell 1970). Large ice-rafted boulders are also present in some areas (Thurston and Choromanski 1994). Over 40,000,000 tons of sediment are discharged per year into the inlet by the surrounding major drainages (Rember and Trefry 2005). Sediment transport in some areas of Upper Cook Inlet has been shown to be exceptionally high, with 10,000 to 100,000+ cubic yards of sediment moving in and out of the Port of Anchorage area in a matter of days or weeks (USACE 2013). A combination of shallow water, high tidal fluctuations, and strong currents constantly mobilize seafloor sediments in the inlet, keeping sediments in suspension, resulting in highly turbid water, and inhibiting deposition of fine-grained sediments (Rember and Trefry 2005). Fine sediments introduced by major rivers feeding into Upper Cook Inlet are carried in suspension, and have been shown to be deposited as far as 150 miles south in Lower Cook Inlet (ADL 2001).

Waterbody substrate data from the onshore environment at the Amakdedori Port site are limited. Sediment from two ponds, one about 0.5 mile north and the other approximately 3 miles south, was described as mud/fine (Grossman 1998).

Chemical Substrate and Sediment Quality

Although numerous studies have been conducted on water quality in Cook Inlet, data on sediment quality in the inlet are sparse. Limited data from dredging operations and sediment sampling in Cook Inlet suggest that sediments generally have low concentrations of contaminants and potential toxins (USACE 2013; ADL 2001). Low levels of hydrocarbons have been detected at multiple sites in the inlet, potentially connected with offshore oil development, past oil spills, or natural oil seeps. Glacial sediments, which are continually transported into the inlet by the major drainages, may contain associated metals and hydrocarbons. Municipal discharges and seafood processing also contribute potential contaminants to Cook Inlet substrate. Extreme tidal fluctuations and strong currents constantly disperse and dilute potential pollutants in the inlet (ADL 2001).

No known sediment sampling has been conducted to date at the proposed port site. Sediment sampling in Kamishak Bay is scheduled for the 2018 field season to characterize dredge spoils (PLP 2018). This section will be updated as new data are received. Samples of fine sediment were collected from the offshore estuarine environments of Iliamna and Iniskin bays, 30 miles northeast of the port site. Some of the samples showed arsenic, copper, nickel and zinc levels higher than the threshold of biological response, and measurable hydrocarbons. There is no significant development in the area, but there is minor marine vessel traffic from Williamsport at the head of Iliamna Bay. Estuarine sediments are generally more fine-grained than what is expected at the offshore Amakdedori Port site, which is more exposed to open water. Fine grained sediments generally retain chemical pollutants more than coarse-grained sediments, due to higher surface area to volume ratios.

Chemical substrate data from the onshore environment at the Amakdedori Port site are limited. Sediment from two ponds, one within 0.5 mile to the north and one about 3 miles south of the port site, were analyzed by NURE and were reported to have no contamination source (Grossman 1998).

3.18.6 Transportation Corridor

The Transportation Corridor would connect the Amakdedori Port site to the Mine Site. The corridor would include a private double-lane access road between the Amakdedori Port and the South Ferry Terminal on Iliamna Lake west of Kokhanok; a similar access road between the North Ferry Terminal on the north shore of Iliamna Lake and the mine site; and a purpose-built ice-breaking ferry connecting the two ferry terminals. The Natural Gas Pipeline would parallel The Transportation Corridor from the Amakdedori Port site to the Mine Site. Additional spur roads would be built to connect the access road to the villages of Iliamna, Newhalen, and Kokhanok.

The 84-mile-long access corridor would cross numerous streams within the Bristol Bay and Cook Inlet watersheds. The corridor originates in the Nushagak watershed at the Mine Site, and traverses the Kvichak watershed; both are within the greater Bristol Bay watershed. The corridor terminates in the Tuxedni-Kamishak bays watershed of the greater Cook Inlet watershed.

3.18.6.1 Surface Water Quality

Sixteen surface water sampling stations were established and sampled in the Transportation Corridor analysis area during 2004 and 2005. The surface water sampled at these stations was characterized by low levels of TDS (2 to 126 mg/L), mostly near-neutral pH (4.6 to 8.8), and high DO concentrations (9 to 19 mg/L). During months when surface water samples were collected, the temperature ranged from 0.1°C to 23°C. The full annual range of water temperatures could not be characterized because samples were not collected during November, December, or January. The cation composition of the water samples was dominated by calcium. The anion composition was typically dominated by bicarbonate, but some samples were dominated by sulfate. The water composition at most stations was consistent between sampling events, but a few stations had an anion composition that varied over time. Concentrations of nutrients were low; specifically, most ammonia and phosphorous concentrations were below the method reporting limit. Total nitrate+nitrite averaged 1 mg/L. Concentrations of the trace elements aluminum, copper, lead, and zinc were above the most stringent ADEC maximum criterion in a few cases.

Iliamna Lake

The sample data suggest that Iliamna Lake has water quality conditions similar to the natural conditions of other regional lakes. Only aluminum, copper, iron, lead, manganese, zinc, and alkalinity were detected at concentrations that were outside the most stringent ADEC water quality criteria. Cation and anion dominance was generally characteristic for temperate lakes. Concentrations of major ions did not vary with depth, suggesting that the water at the sampling sites were well mixed. The concentrations of several major ions and TDS were lower earlier in the summer, peaked in September, and declined again in October. These temporary increases may be associated with the influence of inflow from streams and precipitation.

3.18.6.2 Sediment Quality

The Transportation Corridor crosses numerous streams in the Bristol Bay and Cook Inlet watersheds, and includes an 18-mile traverse of Iliamna Lake. Substrate sediments intersected include a wide range of fine to coarse sediments, with little to no known existing contamination (Grossman 1998). Sediments at the northern end of the corridor overlap with those of the Mine Site. Please see discussion of data in Section 3.18.4, Mine Site.

The Transportation Corridor crosses numerous streams in the Bristol Bay and Cook Inlet watersheds, and includes an 18-mile traverse of Iliamna Lake. Substrate sediments intersected include a wide range of fine to coarse sediments, with little to no known existing contamination (Grossman 1998). Sediments at the northern end of the corridor overlap with those of the Mine Site. Please see discussion of data in Section 3.18.4, Mine Site.

Physical Substrate and Sediment Description

Mine Access Road and Iliamna Spur Road

The Mine Access Road would include a bridge over UTC, and the Iliamna Spur Road includes a bridge across the Newhalen River. General data for UTC substrate (not site-specific to bridge crossing) shows medium to coarse gravels to small cobbles, with some boulders, sands, and silts (Knight Piésold 2011; R2 et al. 2011) No data are currently available on stream or pond substrates crossed by the Mine Access Road or Iliamna Spur Road bridges. [Note: Additional information on substrates has been requested in RFI 036; section to be revised when received.].

Iliamna Lake

A small number of nearshore and deeper water sediment samples from Iliamna Lake were collected between 2004 and 2008. No specific sediment descriptions were provided, except that sediment analyzed was fine-grained material (HDR Alaska 2011). Additional sediment sampling from Iliamna Lake is scheduled for the 2018 field season (PLP 2018). This section will be augmented with new data as they are available.

Southern Access Road

The Southern Access Road traverses five bridges, including the Gibraltar River Bridge, Unnamed Creeks 1, 2, and 3 Bridges, and Bridge Lake Bridge. No data are currently available on stream substrate for these drainages. [Note: Additional information on substrates has been requested in RFI 036; section to be revised when received.]. Samples of substrate from four ponds within approximately 5 miles of the Southern Access Road were all recorded as mud/fine sediment (Grossman 1998).

Chemical Substrate and Sediment Quality

Mine Access Road

Of the 12 pond substrate samples analyzed by NURE within approximately 20 miles of the Mine Access Road, none showed evidence of contamination (Grossman 1998).

Iliamna Lake

A small number of nearshore and deeper water sediment samples from Iliamna Lake were analyzed for trace elements (HDR Alaska 2011). Sediment data showed levels for copper, lead, aluminum, iron, and manganese that were outside the ADEC freshwater criteria. This is likely due to the highly mineralized local geology, and is similar to chemistry in other area lakes. Additional sediment sampling from Iliamna Lake is scheduled for the 2018 field season (PLP 2018). This section will be augmented with new data as they are available.

Southern Access Road

Of the four pond substrate samples analyzed by NURE within approximately 5 miles of the Southern Access Road; none showed any evidence of contamination (Grossman 1998).

3.18.7 Natural Gas Pipeline Corridor

The Natural Gas Pipeline would parallel the Transportation Corridor from the Amakdedori Port site to the Mine Site. The surface water, groundwater, and sediment resources within the Natural Gas Pipeline Corridor are a subset of those resources that are within the Transportation Corridor, with the addition of the short stretch of pipeline that would be constructed along the western shore of the Kenai Peninsula and the subsea pipeline in Cook Inlet.

3.18.7.1 Physical Substrate and Sediment Description

Kenai Peninsula

Potential waterbody crossings along the Kenai Peninsula stretch of the Natural Gas Pipeline Corridor would be limited to minor drainages. Limited sediment sampling from one stream in the area reveals a substrate of fine-grained sediment (Grossman 1998).

Cook Inlet

A general description of Cook Inlet physical substrate and sediment is provided under Section 3.18.5, Amakdedori Port, above. As the Natural Gas Pipeline Corridor traverses 94 miles across Cook Inlet, and publically available information regarding the substrate of CI in this area is sparse, at best. Additional discussion of deeper offshore sediments in Cook Inlet will be included here if data become available.

Water depths in the center of Cook Inlet range from about 50 to over 500 feet (NOAA nautical chart #16660). Numerous oil and natural gas pipelines currently span the bottom of Cook Inlet. Pipeline damage has previously been documented from boulders mobilized on the seafloor by strong tides and currents.

3.18.7.2 Chemical Substrate and Sediment Quality

Kenai Peninsula

Potential waterbody crossings along the Kenai Peninsula stretch of the Natural Gas Pipeline Corridor would be limited to minor drainages. Sediment sampled from one stream in the area did not show evidence of contamination (Grossman 1998).

Cook Inlet

No known sediment quality data are currently available for the Natural Gas Pipeline Corridor Cook Inlet crossing. Sediment sampling at the proposed Amakdedori Port site in Kamishak Bay, 2 miles south of the western terminus of the proposed pipeline Inlet crossing, is scheduled for the 2018 field season (PLP 2018). Seafloor substrate in Lower Cook Inlet generally has low toxicity (ADL 2001).

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3.22 WETLANDS / SPECIAL AQUATIC SITES AND WATERBODIES

This section addresses the existing conditions of wetlands/special aquatic sites and waterbodies in the Environmental Impact Statement (EIS) Analysis Area. The Analysis Area for wetlands and waterbodies encompasses the major watersheds that could potentially be directly or indirectly impacted by the Pebble Project. These watersheds are defined by the United States Geologic Survey (USGS) Hydrologic Unit Code (HUC) level 5, designated as HUC 10 watersheds. There are a total of nine HUC 10 watersheds that make up the analysis area, with a total area of approximately 6,420,000 acres. Detailed information on all wetlands and waterbodies within this large area is not available. A subset of this area was therefore chosen for detailed study and mapping, referred to hereafter as the "mapping area." The mapping area is comprised of four subsets that correlate to the main project components: the Mine Site mapping area, the Transportation/Natural Gas Pipeline Corridor mapping area, the Amakdedori Port mapping area, and the Natural Gas Pipeline Corridor mapping area (Figure 3.22-1 through Figure 3.22-6). The mapping area exceeds project area, the area of the direct project disturbance footprint.

The description of wetlands and waterbodies in the mapping areas is based on information provided in Chapters 14 and 39 of the Environmental Baseline Document (EBD) (3PPI and HDR 2011, HDR and 3PPI 2011), as well as more recent information provided in the Preliminary Jurisdictional Determination (PJD) Report (HDR 2018) (Appendix J) and associated Geographic Information System (GIS) database that reflects changes in the project area since publication of the EBD. The analysis of environmental consequences in Chapter 4 makes use of publically available environmental data for the component watersheds within the analysis area in order to contextualize project impacts.

Wetlands and waterbodies encompass a number of disciplines that are addressed more fully in other sections of this EIS, including soils (Section 3.14), hydrology (Sections 3.16 and 3.17), and vegetation (Section 3.26). Wetland and waterbody functions and values that overlap with and are developed in other sections include water and sediment quality (Section 3.18), wildlife values and threatened and endangered species (Sections 3.23 and 3.25), aquatic species habitat (Sections 3.23, 3.24, and 3.25), and food and fiber production (subsistence) (Section 3.9).

The affected environment for wetlands and waterbodies includes vegetated wetlands, ponds, lakes, streams, rivers and marine waters that may be directly or indirectly affected by the project. Wetlands and waterbodies will be described in terms of the extent and characteristics of predominant types found in the main project component mapping areas.

3.22.1 Substrate (Wetlands)

Wetlands and waterbodies are considered "waters of the U.S.," which are defined in the Clean Water Act as "surface waters, including streams, streambeds, rivers, lakes, reservoirs, arroyos, washes, and other ephemeral watercourses and wetlands" (33 Code of Federal Regulations [CFR] Part 328.3[a]). Special aquatic sites are a subset of waters of the U.S. that are large or small areas possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values (40 CFR 230.3). Special aquatic sites present in the vicinity of the analysis area include wetlands (defined below), mud flats, vegetated shallows, and riffle and pool complexes.

Mud flats occur in some of the intertidal portions of Cook Inlet. They are composed of fine sediments and organic material, and are either unvegetated or vegetated only by algal mats. They have not been documented in the mapping area, as the intertidal zone is composed mostly of sand and gravel. Vegetated shallows are permanently inundated areas that support rooted aquatic vegetation. They include some of the aquatic bed types defined by the National Wetland Inventory (NWI) system (described below) occurring in freshwater ponds and lake margins. These are of very limited extent in the mapping area, and are described together with other vegetated wetlands. Eelgrass beds are a relatively common type of vegetated shallows that do occur in parts of the nearshore environment of Cook Inlet. However, they have not been documented within the mapping area.

Riffle and pool complexes occur in steep gradient sections of streams within the mapping area. Riffles are defined by rapid flow over a coarse substrate that produces high levels of dissolved oxygen in the water. Pools are deeper, slower sections of water with a finer substrate. Major streams in the analysis area have been characterized for habitat types, including riffle and pool habitats and associated fish resources (R2 Resource Consultants et al. 2011). Baseline mapping of streams did not specifically identify riffle and pool complexes in the mapping area. Streams were characterized mainly by flow regime (lower perennial, upper perennial and intermittent). Riffle and pool complexes would be expected to occur most frequently in the upper perennial and intermittent zones where stream beds are predominantly gravel or coarser. Stream morphology and associated fish habitat in the analysis area is addressed in Section 3.24 of this EIS.

Wetlands are special aquatic sites defined as, "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3[b]). Unvegetated areas such as streams, ponds, and lakes are not considered "wetlands" under this definition.

Wetland determinations followed guidance from the U.S. Army Corps of Engineers (USACE). Wetland determinations from 2004 through 2008 were based on the 1987 Wetland Delineation Manual (USACE 1987), while determinations after 2013 were based on the 1987 Manual in conjunction with the 2007 Alaska Regional Supplement (USACE 2007). Both manuals use field indicators to determine presence of vegetation, soils and hydrology characteristic of wetlands. Detailed descriptions of the field indicators used for wetland determinations in the mapping area are provided in Chapters 14 and 39 of the EBD (3PPI and HDR 2011, HDR and 3PPI 2011), and in the PJD Report (HDR 2018).

3.22.2 Analysis Methodology (Categories, Classes, and Functions)

The wetlands and waterbodies mapping area for the Pebble Project encompass approximately 45,000 acres. To facilitate wetlands and waterbody mapping, a GIS database was constructed that incorporates several project-specific layers, including existing NWI mapping, USGS topographic mapping, land use and land cover mapping, existing vegetation mapping, soil survey data from the Natural Resources Conservation Service (NRCS), and several sources of aerial and Light Detection and Ranging (LiDAR) imagery.

Field survey protocols were developed to collect pertinent field data over several growing seasons (2004-2008, 2013 and 2017). A total of 684 wetland determination field plots were surveyed. Detailed information on vegetation, soils, and hydrology were collected at each plot. Additional photo and data points were collected at waterbodies and stream crossings. Additional vegetation data was also collected to support vegetation type classification and mapping. Field data was recorded on Global Positioning System (GPS) units, digital cameras, field forms and field notebooks. Field data was used in GIS with other data layers, to digitally map wetland and waterbody polygons.

Mapping was digitized on aerial photography at a scale between 1:1,200 and 1:1,500, for wetlands, and 1:400 for open water. Mapping of wetlands relied heavily on interpretation of "photographic signatures" associated with vegetation types (see Appendix C in HDR 2018,) (see PJD included as Appendix J). Interpretation of topography was also important in mapping wetlands and waterbodies. Topographic depressions, toeslopes and flat areas were often associated with wetlands, while convex slopes were indicative of potential uplands. Topography was also used to assess potential hydrologic connections between wetlands and surface waters, and to determine potential locations of groundwater seeps.

Each mapped wetland and waterbody polygon was further characterized using three classification systems. All polygons were first assigned a vegetation type based on the Alaska Vegetation Classification (Viereck et al. 1992), supplemented by Wibbenmeyer et al. (1982). Vegetation classification and mapping is discussed in detail in Section 3.26 of this EIS. Wetland and waterbody polygons were also classified based on NWI class (Cowardin et al. 1979) and Hydrogeomorphic (HGM) class (Brinson 1993), described below.

Field studies and mapping conducted as part of the environmental baseline program encompassed the portion of the mapping area within the Bristol Bay watershed, and the west side of the Cook Inlet watershed. This includes the Mine Site, the Transportation/Natural Gas Pipeline Corridor (including the ferry terminals and pipeline crossing at Iliamna Lake), and the Amakdedori Port. The pipeline crossing of Cook Inlet and the pipeline corridor and compressor station on the Kenai Peninsula were not included in the field studies and mapping prepared for the Pebble Project. Therefore, this analysis makes use of existing wetlands mapping that is publically available, primarily the Cook Inlet Lowlands wetland mapping prepared by the Kenai Watershed Forum (Gracz 2013). Wetlands were mapped on the Kenai Peninsula using stereo-paired aerial photography at a scale of 1:24,000, in conjunction with NWI maps and NRCS soils data. Approximately 10 to 20 percent of the wetland polygons were field checked.

The Cook Inlet Lowlands mapping utilized a project-specific wetland classification system (Gracz 2014). The system is largely based on hydrologic and geomorphologic factors, and is therefore similar to the HGM method. In order to make the data comparable to the data collected for the Pebble Project, the Cook Inlet wetland classes were reclassified with the best-corresponding HGM and NWI classes.

Pebble Limited Partnership (PLP) submitted geodatabases with the wetland and waterbody mapping to the USACE in December 2017 with a request for a PJD for the Pebble Project. The USACE issued their PJD on March 20, 2018, confirming the wetland and waterbody mapping.

3.22.2.1 National Wetland Inventory Classification

The NWI classification system has been used by the U.S. Fish and Wildlife Service since 1979 to classify and map wetlands and deepwater habitats throughout the U.S. Under this classification scheme, wetlands and deepwater habitats are grouped into systems based on shared hydrologic conditions. NWI systems occurring in the mapping area are palustrine, lacustrine, riverine, and marine.

Most vegetated wetlands within the mapping area classify as palustrine, which is further subdivided by dominant vegetation growth forms (trees, shrubs, emergent herbaceous, aquatic herbaceous, or moss/lichen) or bed type (for non-vegetated ponds less than 20 acres). Palustrine forested wetlands occur in a very small portion of the mapping area. These are represented primarily by broad leaved deciduous forests (PFO1) confined to valley bottoms. Primary tree species include alders (*Alnus incana, A. viridis*), various willows (*Salix sp.*), and balsam poplar (*Populus balsamifera*).

Palustrine scrub-shrub wetlands are the dominant NWI class in the mapping area. These include wetlands dominated by broad leaved deciduous shrubs (PSS1) such as birches *(Betula* *glandulosa, B. nana*), and willows; broad leaved evergreen shrubs (PSS3) such as sweetgale (*Myrica gale*), Labrador-tea (*Rhododendron tomentosum, R. groenlandicum*), bog-rosemary (*Andromeda polifolia*), black crowberry (*Empetrum nigrum*), and northern mountain-cranberry (*Vaccinium vitis-idaea*); and needle leaved evergreen shrubs (PSS4) represented by stunted black spruce (*Picea mariana*).

Palustrine emergent wetlands (PEM1) make up the second-most dominant NWI class in the mapping area. These include wetlands dominated by a large number of persistent, herbaceous species adapted to a wide range of saturation or non-permanent flooding. Common plants in the mapping area include bluejoint (*Calamagrostis canadanesis*), numerous sedges, rushes (*Juncus sp.*), horsetails (*Equisetum sp.*), cotton-grasses (*Eriophorum sp.*), and numerous other grasses and forbs.

Palustrine aquatic bed wetlands (PAB3) occur in small ponds and other semipermanently to permanently flooded areas. They are dominated by rooted, aquatic herbaceous species such as yellow pond-lily (*Nuphar luteum*) and pondweeds (*Potamogeton sp.*).

Waterbodies larger than 20 acres situated in depressions are classified as lacustrine, which are generally unvegetated but may include aquatic herbaceous species. Waterbodies contained within a channel (rivers and streams) are classified as riverine. Riverine classes are subdivided by flow regime (lower perennial, upper perennial and intermittent) and are mostly unvegetated in the mapping area. The marine system is mapped on shorelines of Cook Inlet, and is subdivided based on tidal regime (subtidal or intertidal).

NWI classification for the Pebble Project also utilized water regime modifiers for each polygon. Water regimes included temporarily flooded, saturated, seasonally flooded, semipermanently flooded, and permanently flooded. Water regimes are often difficult to determine based on a single field observation during one time of the year. Interpreting water regimes from aerial photography is also particularly difficult unless photography from multiple years and seasons are available. For these reasons, NWI water regime modifiers are not used in the analysis for this EIS.

3.22.2.2 Hydrogeomorphic Classification

The HGM classification groups wetlands into categories based on the geomorphic and hydrologic characteristics that control many wetland functions. HGM classes observed in the mapping area include slope, riverine, depressional, flats and lacustrine fringe wetlands. Two additional HGM types were described for waterbodies in the Pebble Project: lacustrine waters and riverine channel waters. Estuarine/coastal fringe wetlands (e.g., salt marshes) occur along some of the tidally influenced shorelines of Cook Inlet and its estuaries, but have not been described in the mapping area (HDR and 3PPI 2011). Marine waters are described as either subtidal or intertidal, depending on whether they are normally flooded or exposed during periods of low tide. HGM classes are described below.

Slope Wetlands are the most common wetlands in the mapping area, occurring on hill or valley slopes where groundwater "daylights" and begins running along the surface, or immediately below the soil surface. While groundwater discharge is the primary water source, surface flow and precipitation also contribute water. Water in these wetlands flows in one direction only (i.e., down the slope), and the gradient is steep enough that the water is not impounded. The "downhill" side of the wetland is always the point of lowest elevation in the wetland. Water is lost through subsurface and surface outflow and evapotranspiration. Slope wetlands in the mapping area commonly occur as seeps on footslopes and toeslopes, and as headwaters and drainage ways in steep to rolling terrain where stream channels have not yet formed. Slope wetlands also occur as fens and string bogs.

Riverine Wetlands are the second-most common wetlands in the mapping area, occurring in valleys associated with stream or river channels. They lie in active floodplains and riparian corridors and have important hydrologic links to the water dynamics of the river or stream. The distinguishing characteristic of riverine wetlands is that they are flooded by overbank flow from the stream or river at least every other year. Subsurface hyporheic flow, groundwater discharge, overland flow and precipitation can also provide important seasonal inputs. Water loss is through flow returning to the channel, subsurface discharge to the channel, seepage to groundwater, and evapotranspiration. Riverine wetlands range from broad floodplains along large meandering rivers to narrow zones along higher gradient rivers and streams. Riverine wetlands are often modified by beaver activity.

Riverine Channel includes wetlands and waters contained within the active channel of intermittent or perennial streams or rivers. Both bare and vegetated sand and gravel bars, and flowing waters with or without aquatic vegetation are included. The outer extent of the channels is defined by the ordinary high water mark (OHWM).

Depressional Wetlands occur in depressions where elevations within the wetland are lower than in the surrounding landscape. The shapes of depressional wetlands vary, but in all cases, the movement of surface water and shallow subsurface water is toward the lowest point in the depression. The depression may have an outlet, but the lowest point in the wetland is somewhere within the boundary, not at the outlet. Water sources include precipitation, groundwater discharge, and surface flow often with seasonal vertical fluctuations. Water loss is through intermittent or perennial outflow, evapotranspiration or seepage to groundwater. In the mapping area, depressional wetlands occur as abandoned river features on terraces (oxbows) above active floodplains or as kettles on moraine landforms. Depressional wetlands are often embedded within other HGM wetland classes.

Flats Wetlands occur in topographically flat or very gently sloping areas that are hydrologically isolated from surrounding ground or surface water. Precipitation provides the dominant source of water, with water loss from evapotranspiration, overland flow, and seepage to groundwater. In the mapping area, flats wetlands may occur on either mineral soil or accreted organic matter similar to extensive peatlands. They are present on broad ridgetops, glacial outwash terraces and remnant glacial lake beds. They may transition to slope wetlands at topographic breaks associated with groundwater discharge.

Lacustrine Fringe Wetlands occur next to lakes that maintain the water table in these wetlands; surface flow is bi-directional. Additional water sources are precipitation and groundwater discharge. Water loss is through flow returning to the lake and by evapotranspiration. These wetlands are of limited extent in the mapping area.

Lacustrine Waters include the unvegetated water in lakes that are greater than 20 acres in size or at least 6.6 feet deep at low water. The upper extent of this type is defined by the OHWM on the shore. Open water depressions that do not meet the size requirements of lakes are classified as ponds for this analysis.

3.22.2.3 Wetland Functions and Values

Wetlands provide numerous ecosystem services or functions that are considered valuable to society. They support numerous species of plants and provide necessary habitat for fish, wildlife, and insects throughout various stages of their life cycles. Wetlands provide feeding, breeding, rearing, and cover habitat for numerous animals. Wetlands also act as filters while providing flood control, sedimentation, erosion control, and the stabilization of shorelines (USACE 2009; Magee and Hollands 1998).

A wetland functional assessment will be prepared as part of the permitting process for the Pebble Project, and is typically used to quantify wetland impacts and corresponding compensatory mitigation needs (USACE 2016). This section provides only a very general, qualitative overview of wetland functions in the mapping area based on the NWI and HGM classifications. Wetland functional capacity varies greatly depending on position in the watershed and linkages to other habitats, so a particular wetland polygon of a given class may not provide the same level of functions as others in the same class.

In particular, the following characteristics are considered indicative of high-functioning wetlands in the mapping area:

- Provide habitat for threatened or endangered species (see Section 3.25, Threatened and Endangered Species [TES], for information on TES species), or provide habitat for sensitive or important fish, wildlife, birds, or plant species;
- Are regionally scarce, or rare and high quality, within a given region. For example, forested wetlands, often found near streams, account for less than one percent of wetlands in the mapping area, but provide important food and cover for wildlife, and woody inputs important for stream dynamics; or
- Are undisturbed and difficult or impossible to replace within a lifetime such as certain bogs and fens with their unique plant communities that may take centuries to develop. Bogs make up approximately 12 percent of wetlands in the mapping area. Bog vegetation types include: ericaceous shrub bog, open dwarf birch bog-ericaceous shrub bog, and open sweetgale-graminoid bog (Viereck et al. 1992). Bogs, which occur primarily on flats and slope HGM positions, have also been shown to contribute substantially to stream base flows (Gracz 2017).

In addition to the ecosystem functions provided by wetlands, certain wetland types and locations are valued by Alaska Natives for their subsistence value (Hall et al. 1994; Jernigan n.d.). Some culturally important plants found mainly in wetlands include blueberries, cranberries, Labrador tea, and willows.

Primary wetland functions generally associated with each wetland class are described below.

Forested Wetlands – provide modification of flood flows, shoreline stabilization, water quality improvement, organic matter production and export, wildlife cover and browse, and fish habitat through cover and shade.

Scrub-Shrub Wetlands – tall shrubs provide water quality and shoreline stabilization functions similar to forested wetlands, and high quality wildlife browse (willows).

Emergent and Aquatic Bed Wetlands – persistent herbaceous vegetation provides removal of sediments and nutrients, production and export of organic matter, and habitat for aquatic invertebrates, fish, waterfowl and wetland-associated mammals (beavers and river otters).

Slope Wetlands – modification of groundwater discharge, mediation of surface and subsurface flows to other wetlands, and support of stream base flows which indirectly supports seasonal fish habitat.

Riverine Wetlands – floodwater storage, modification of stream flows, water quality improvement, and general fish habitat.

Depressional Wetlands – groundwater recharge, floodwater storage, and water quality improvement.

Flats Wetlands – surface water storage, mediation of surface and subsurface flow to other wetlands and streams, production and export of organic matter, and maintenance of characteristic plant communities (bogs and fens).

Lacustrine Fringe Wetlands – floodwater storage, water quality improvement, shoreline stabilization, and habitat for aquatic invertebrates, fish, and waterfowl.

3.22.3 Wetlands in the Mapping Area

Approximately 35 percent of the mapping area was determined to be a wetland or waterbody, and assumed to be subject to USACE jurisdiction. Total vegetated wetland area was calculated as approximately 10,048 acres (22 percent). Statewide, approximately 43 percent of Alaska is estimated to be wetland (Hall et al. 1994). Many of the wetland polygons mapped for the Pebble Project contain inclusions of uplands. These "mosaics" occur in landscapes with often complex microtopography where wetland and upland components are too closely associated to be easily mapped separately (USACE 2007). During the mapping, wetland scientists estimated the proportion of wetland versus upland in each mosaic polygon, ranging from 10 to 90 percent wetland. Almost half of the wetland polygon area in the mapping area was mapped as mosaics. Scrub-shrub and forested wetlands were more often mapped as mosaics compared to emergent wetlands. For this analysis, all mosaics have been calculated as 100 percent wetland.

The majority of the mapping area is within the Bristol Bay drainage. This includes the Mine Site and supporting infrastructure, the mine access road and pipeline corridor from Iliamna Lake, the north and south ferry terminals on Iliamna Lake, and much of the south access road and gas pipeline corridor from the watershed divide to the south ferry terminal. The rest of the south access road and gas pipeline corridor, as well as Amakdedori Port, and the pipeline corridor on the Kenai Peninsula are within the Cook Inlet drainage. Wetland and waterbody areas and proportions are shown in Table 3.22-1.

A total of 50 different NWI types were observed and mapped across the entire wetland mapping area. For purposes of this analysis, these have been summarized into ten functionally similar groups (Table 3.22-2).

[Note: Numbers at this time throughout this section may not reconcile exactly with numbers presented in Section 3.26-Vegetation, due to refinements in the specific project area.]

Table 3.22-1: Wetland and Waterbody Comparisons by Project Component

Project Component	Mapping Area (acres)	Wetland (acres)	Wetland (%)	Waterbodies (acres)	Waterbodies (%)
Mine Site	20,526	7,067	34	503	2
Transportation/Natural Gas Pipeline Corridor[1]	20,127	2,930	15	1,275	6
Amakdedori Port	3,973	49	1	3,425	86
Natural Gas Pipeline Corridor[2]	377	2	1	341	91
Totals	45,003	10,048	22	5,544	12

Notes:

1 From the Amakdedori Port to the Mine Site, including the south and north ferry terminals and the crossing of Iliamna Lake.

2 Includes the section on the Kenai Peninsula and the crossing of Cook Inlet.

Source: HDR 2018

Table 3.22-2: NWI Types and Groups in the Mapping Area

Deciduous Forest	Shrubs		Herbaceous	Aquatic Bed	Ponds	Lakes	Rivers/Streams	Marine
	Broad Leaved Deciduous	Evergreen						
PFO1	PSS1/4	PSS3/1	PEM1/SS1	PAB	PUB	L1UB	Perennial	Subtidal
PFO1/EM1	PSS1/3	PSS3	PEM1/SS3	PAB3	PUB/AB	L2UB	R2UB	M1UB
PFO1/EM2	PSS1	PSS3/EM1	PEM1	PAB3/EM2	PUB/AB3	L2US	R2US	
	PSS1/FO1	PSS4	PEM2	PAB3/UB	PUB/EM1	L2EM2	R3UB	Intertidal
	PSS1/FO4	PSS4/1	PEM1/ ML1	L2AB	PUS		R3US	M2US1
	PSS1/EM2		PEM1/2	L1UB/AB3	PUS/EM1			
	PSS1/ML1		PEM1/US		PUS/EM2		Intermittent	
	PSS1/ML2		PEM1/UB				R4SB	
	PSS1/US							
	PSS1/EM1							

Acres and proportions of the various NWI groups across the entire mapping area are provided in Figure 3.22-7. Broad Leaved Deciduous Shrubs, Marine Subtidal, and Herbaceous NWI groups combined make up approximately 88 percent of the mapping area. The acres and proportions of NWI vegetated wetland groups are provided in Figure 3.22-8. The Broad Leaved Deciduous Shrubs group makes up approximately 73 percent of all vegetated wetlands. Primary shrubs in this group include numerous willow species (e.g., *Salix pulchra, S. barcayi, S. alaxensis*), birches (*Betula nana* and others), and blueberries (*Vacinnium uliginosum* and others). It should be noted, however, that this group often included secondary vegetation types within its mapping units (Table 3.22-2). These included Needle Leaved Evergreen Shrubs (black spruce), Broad Leaved Evergreen Shrubs, Deciduous and Evergreen Forests, Herbaceous, and Moss-Lichen. In addition, the Broad Leaved Deciduous Shrubs group represents several water regimes.

Acres and proportions of HGM classes across the mapping area are shown in Figure 3.22-9. Slope wetlands make up 75 percent of all wetlands in the mapping area. Photographs of representative wetlands and waterbodies in the mapping area are provided in Figure 3.22-10.

Figure 3.22-1: Wetlands Mapping Area Overview

Figure 3.22-2: Wetlands Mapping Mine Site Mapping Area

Figure 3.22-3: Wetlands Mapping Transportation and Natural Gas Pipeline Corridor Mapping Area North of Iliamna Lake

Figure 3.22-4: Wetlands Mapping Transportation and Natural Gas Pipeline Corridor Mapping Area South of Iliamna Lake

Figure 3.22-5: Wetlands Mapping Area Amakdedori Port Mapping Area

Figure 3.22-6: Wetlands Mapping Area Natural Gas Pipeline Mapping Area (Kenai Peninsula)

Figure 3.22-7: Acres and Proportions of NWI Wetland and Waterbody Groups in the Mapping Area

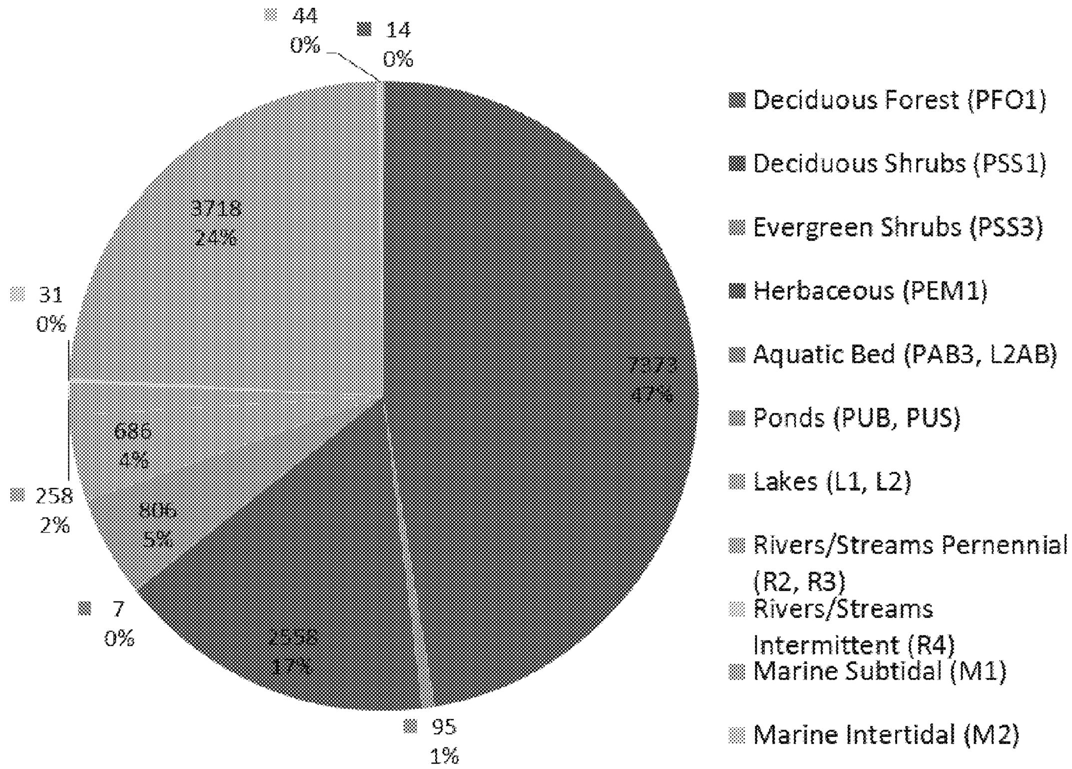


Figure 3.22-8: Acres and Proportions of NWI Vegetation Wetland Groups in the Mapping Area

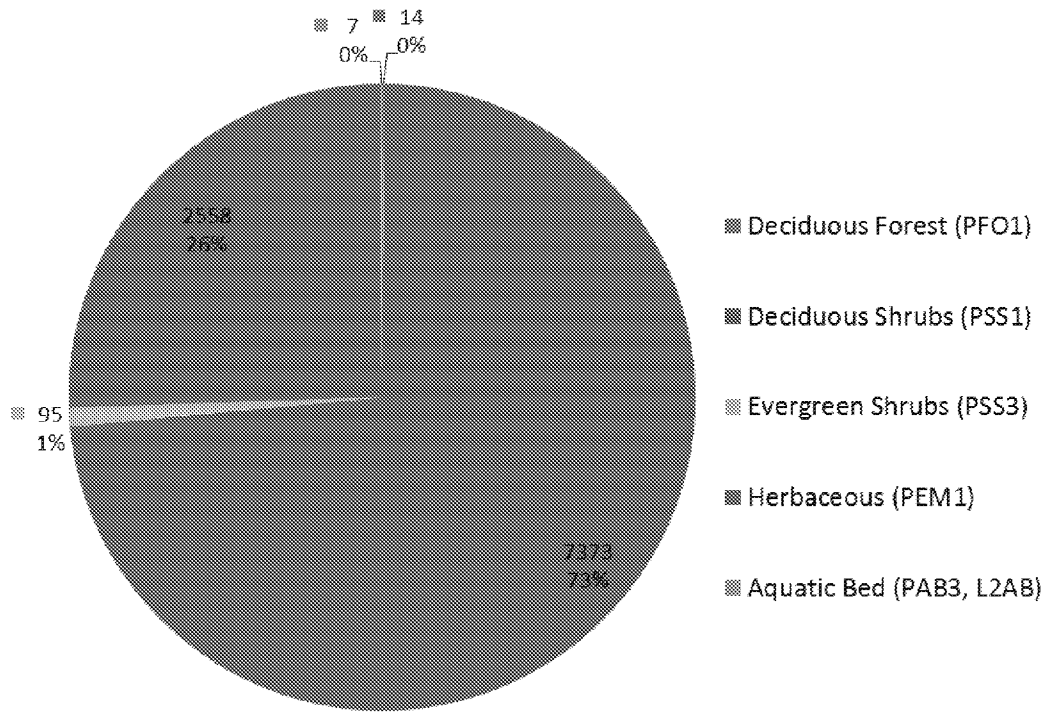
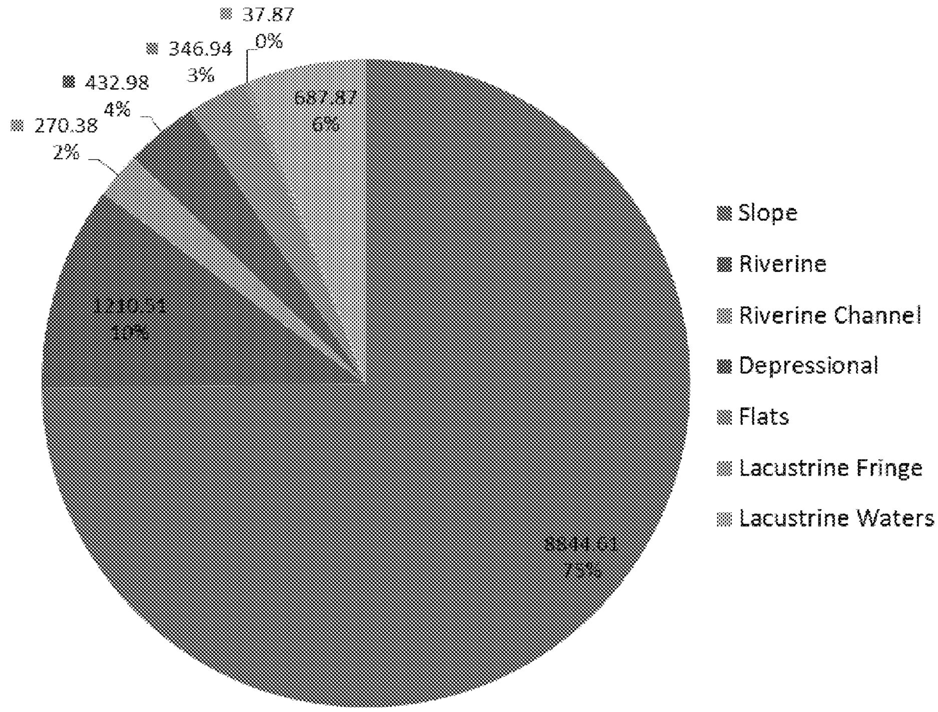


Figure 3.22-9: Acres and Proportions of HGM Classes in the Mapping Area



Notes:

Excludes marine waters, which are not classified by HGM.

Figure 3.22-10: Common Wetland and Waterbody Types in the Mapping Area

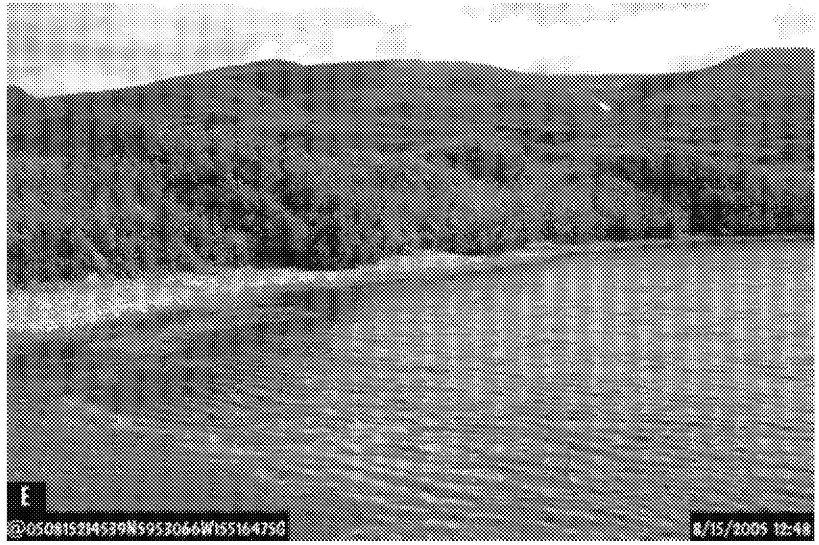
Herbaceous Slope Wetland, PEM1F, Sedges

Herbaceous Flats Wetland, PEM1b, Cotton Grass/Peat

Perennial Stream, R3UBH

Herbaceous Slope Wetland, PEM1B, Sedges/Peat

Evergreen Shrub Flats Wetland, PSS3b, Labrador Tea-Crowberry



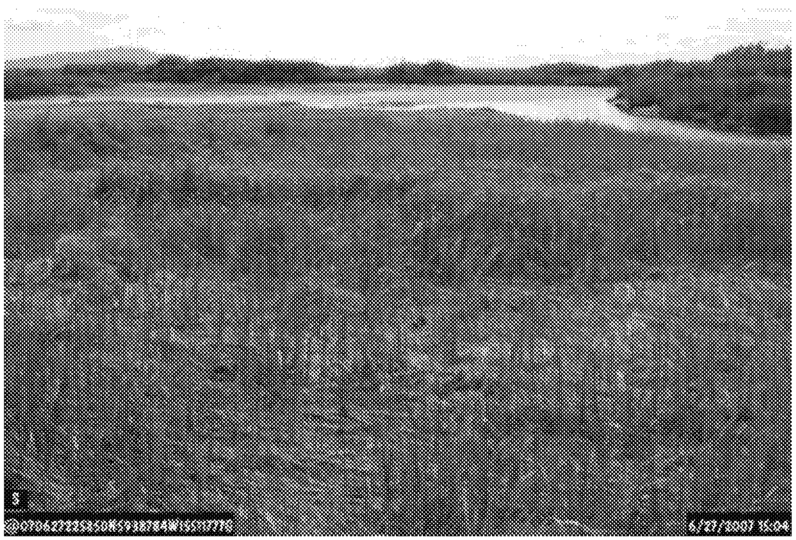
Aquatic Bed Depressional Wetland, PAB3H

Herbaceous Lacustrine Fringe Wetland, PEM1F, Sedges-Rushes

Herbaceous Depressional Wetland, PEM1b, adjacent to Pond

Deciduous Forest Riverine Wetland, PFO1C, Balsam Poplar/Bluejoint

Deciduous Shrub Slope Wetland, PSS1C, Willows/Bluejoint



Herbaceous Riverine Wetland, PEM1C, Sedge-Bluejoint

Evergreen Shrub Slope Wetland, PSS3b, Labrador Tea-Crowberry

3.22.4 Mine Site Affected Environment

The mapping area for the Mine Site is approximately 20,526 acres. It was selected to provide coverage of potential development areas and alternative development areas as well as additional surrounding area to provide comparative context (3PPI and HDR 2011). The fully developed Mine Site would include an open pit, TSF, power plant, water treatment plants, and milling/processing facilities as well as supporting infrastructure. The watershed divide between the South Fork Koktuli River and Upper Talarik Creek is close to the dividing line between the Transportation/Natural Gas Pipeline Corridor mapping area and the Mine Site mapping area. The Mine Site encompasses the upper watersheds of both the North Fork and South Fork Koktuli River, which flows into Bristol Bay via the Mulchatna and Nushagak rivers. It also includes a small portion of the Upper Talarik Creek watershed. The mapping area is composed of glaciated, volcanic-ash influenced, hills and valleys free of permafrost.

Thirty-seven percent of the Mine Site mapping area is wetlands or waterbodies, comprised predominantly of broad leaved deciduous shrub wetlands (PSS1) in slope geomorphic positions (63 percent) (Table 3.22-3, Figure 3.22-11). These occur on both mineral and organic soils. Water regime is usually saturated, but also includes shallow flooding or ponding on very gradual slopes and in small swales and depressions located on the slopes. Although dominated by a deciduous shrub layer (willows, birches, blueberries), they usually also include small evergreen shrubs, with or without herbaceous wetland species. Bogs and fens co-dominated by ericaceous shrubs occur on slopes and organic flats. The broad leaved deciduous shrub NWI group makes up 73 percent of the vegetated wetlands at the Mine Site. The slope HGM class accounts for 87 percent of the vegetated wetlands.

Herbaceous wetlands (PEM1) make up 21 percent of the Mine Site wetlands or waterbodies. These occur in seasonally to semi-permanently flooded depressions and shorelines, and on wetter positions on slopes and flats. Some 30 species of wetland sedges were observed in the mapping area and provide the dominant cover. Some of these sedges, along with cotton-grasses (*Eriophorum sp.*), form pronounced tussocks communities. Bluejoint (*Calamagrostis canadensis*) and horsetails (*Equisetum sp.*) are other locally common herbaceous wetland species.

Riverine wetlands occur along the north and south forks of the Koktuli River, as well as several smaller streams, making up six percent of the Mine Site wetlands and waterbodies. These are mostly seasonally flooded, deciduous shrub wetlands and sedge marshes. Aquatic bed wetlands occurred in depressions and ponded areas of slopes, accounting for less than one percent of wetlands and waterbodies. Deciduous forested wetlands were absent at the Mine Site.

Waterbodies accounted for seven percent of the Mine Site wetlands and waterbodies. Waterbodies included both perennial and intermittent stream channels, lakes, and ponds.

Human-caused soil or vegetation disturbance in the Mine Site mapping area was minimal and appeared to be limited to four-wheeler trails or campsites (3PPI and HDR 2011). Drill pads and other temporary disturbance from project exploration were not observed to alter wetland status or characteristics.

Table 3.22-3: Mine Site Mapping Area Calculation of NWI Groups by HGM Classes

NWI Group	HGM Class (Acres/percent)[1]							Total Area[2] (Acres)	Area (%)
	Slope	Riverine	Riverine Channel	Depression	Flats	Lacustrine Fringe	Lacustrine Waters		
Deciduous Shrub Wetlands	4,736 **63%**	308 4%	0	27 <1%	204 3%	17 <1%	0	5,292	70
Herbaceous Wetlands	1,561 **21%**	150 2%	<1	25 <1%	21 <1%	15 <1%	0	1,772	23
Aquatic Bed Wetlands	2 <1%	0	0	1 <1%	0	0	<1	3	<1
Ponds	44 1%	25 <1%	0	124 2%	0	0	0	193	3
Lakes	0	0	0	0	0	<1	224 3%	224	3
Perennial Streams	0	0	80 1%	0	0	0	0	80	1
Intermittent Streams	0	0	6 <1%	0	0	0	0	6	<1
Wetland/ Water Totals	6,344	483	87	176	225	32	224	7,571	100
Area (%)	84	6	1	2	3	<1	3	37	
Uplands								12,955	63
Totals								20,526	100

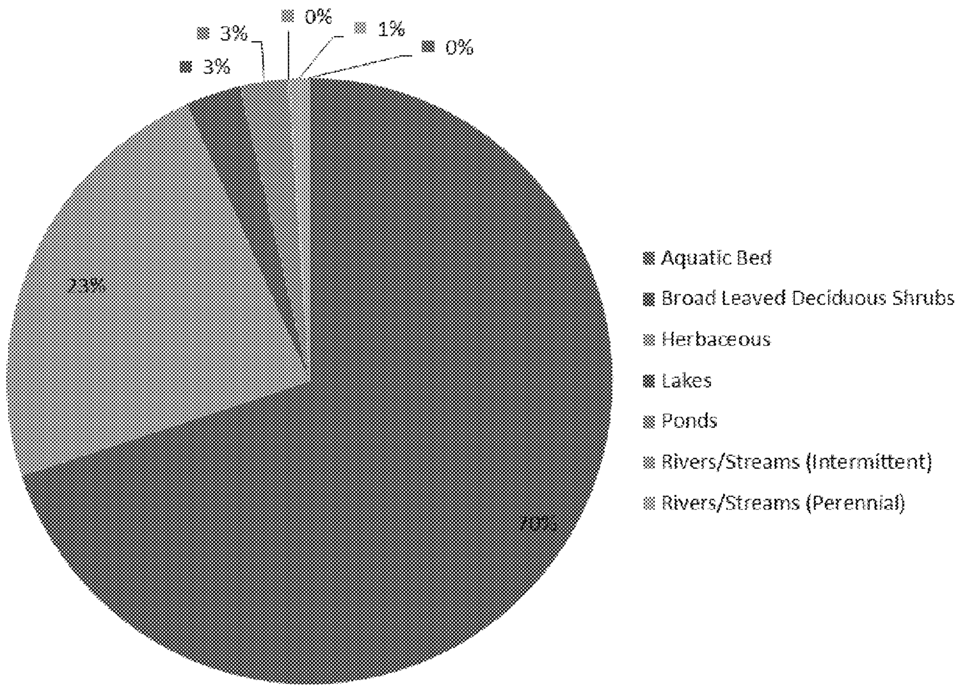
Notes:

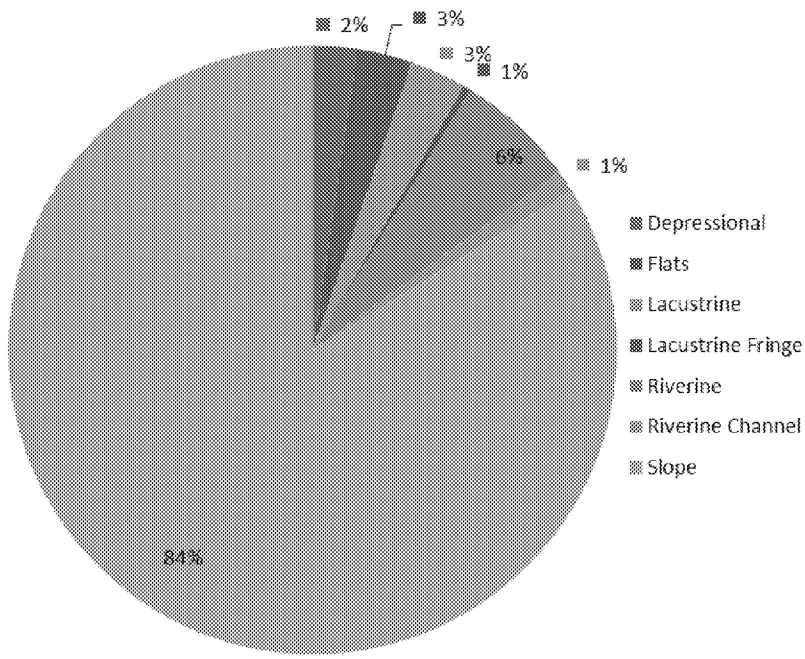
1 Includes percentage of all wetlands and waterbodies within the Mine Site mapping area.

2 The Mine Site mapping area overlaps with approximately 5 miles of the Transportation/Natural Gas Pipeline Corridor. That acreage is included here rather than in the Transportation/Natural Gas Pipeline Corridor mapping area.

Source: HDR 2018

Figure 3.22-11: NWI Groups and HGM Classes at the Mine Site Mapping Area





3.22.5 Transportation/Natural Gas Pipeline Corridor Affected Environment

The mapping area for the Transportation/Natural Gas Pipeline Corridor is approximately 20,128 acres. The mapping area is generally 2,000 feet wide, centered on the proposed road centerline. It ranges up to 8,000-feet wide for approximately 8 miles on the north side of Iliamna Lake to account for other potential road alignments in this area. The corridor includes the Mine Access Road (29 miles) from the Mine Site to the north ferry terminal at Iliamna Lake, an 18-mile crossing of the lake to the south ferry terminal, and the South Access Road (37 miles) between the lake and Amakdedori Port on Cook Inlet. It also includes spur roads to Iliamna Airport (7 miles) and Kokhanok Airport (1 mile). The roads would have a 30-foot wide top width to enable two-way traffic. The pipeline would be buried adjacent to the road bed shoulder, and would either be routed under stream crossings or attached to bridge crossings. The pipeline would cross Iliamna Lake on the lake bed.

The transportation and pipeline corridor crosses numerous streams that feed into Iliamna Lake, which is connected to Bristol Bay via the Kvichak River. The major Bristol Bay watersheds include Upper Talarik Creek, Newhalen River on the north side of Iliamna Lake, Gibraltar Lake on the south side, and Iliamna Lake watershed on both sides of the lake. The major watershed draining to Cook Inlet is the Amakdedori Creek-Kamishak Bay watershed. The transportation and pipeline mapping area is dominated by glaciated, volcanic ash-influenced, mountains, hills, plains and valleys that are free of permafrost.

Twenty-one percent of the transportation and pipeline corridor mapping area is wetlands or waterbodies, comprised predominantly of broad leaved deciduous shrub wetlands (PSS1) in slope geomorphic positions (33 percent) (Table 3.22-4, Figure 3.22-12). These occur on both mineral and organic soils. Water regime is usually saturated, but also includes shallow flooding or ponding on very gradual slopes and in small swales and depressions located on the slopes. Although dominated by a deciduous shrub layer (willows, birches, blueberries), they usually also include small evergreen shrubs, with or without herbaceous wetland species. Bogs and fens co-dominated by ericaceous shrubs occur on slopes and organic flats. Evergreen shrub wetlands (PSS3, PSS4) account for 2 percent of wetlands and waterbodies, and occur primarily on slopes. The broad leaved deciduous shrub NWI group makes up 70 percent of the vegetated wetlands in the mapping area. The slope HGM class accounts for 70 percent of the vegetated wetlands.

Herbaceous wetlands (PEM1) make up 18 percent of the transportation and pipeline corridor wetlands and waterbodies. These occur in seasonally to semi-permanently flooded depressions and shorelines, and on wetter positions on slopes and flats. Some 30 species of wetland sedges were observed in the mapping area and provide the dominant cover. Some of these sedges, along with cotton-grasses (*Eriophorum sp.*), form pronounced tussocks communities. Bluejoint (*Calamagrostis canadensis*) and horsetails (*Equisetum sp.*) are other locally common herbaceous wetland species.

Riverine wetlands occur primarily along Upper Talarik Creek and Newhalen River, making up 17 percent of the mapping area wetlands and waterbodies. These are mostly seasonally flooded, deciduous shrub wetlands and sedge marshes. Deciduous forested wetlands and aquatic bed wetlands each accounted for less than one percent of the mapping area wetlands and waterbodies.

Waterbodies accounted for 30 percent of the transportation and pipeline corridor mapping area wetlands and waterbodies. Waterbodies included both perennial and intermittent stream channels, lakes and ponds.

Human-caused soil or vegetation disturbance in the transportation and pipeline corridor mapping area was minimal and appeared to be limited to four-wheeler trails, roads and building pads near the village of Iliamna, Kokhanok Airport, and the shore of Iliamna Lake.

Table 3.22-4: Transportation/Natural Gas Pipeline Corridor Mapping Area Calculation of NWI Groups by HGM Classes

NWI Group	HGM Class (Acres/percent) [1]							Total Area[2] (Acres)	Area (%)
	Slope	Riverine	Riverine Channel	Depression	Flats	Lacustrine Fringe	Lacustrine Waters		
Deciduous Forest Wetlands	2 <1%	12 <1%	0	0	0	0	0	14	<1
Deciduous Shrub Wetlands	1,382 **33%**	581 **14%**	<1	10 <1%	83 2%	1 <1%	0	2,057	49
Evergreen Shrub Wetlands	94 2%	0	0	1 <1%	0	0	0	95	2
Herbaceous Wetlands	567 **13%**	108 3%	0	43 1%	39 1%	3 <1%	0	760	18
Aquatic Bed Wetlands	<1	<1	0	4 <1%	0	<1	0	4	<1
Ponds	404 **10%**	6 <1%	2 <1%	197 5%	<1	1 <1%	<1	610	15
Lakes	0	0	0	0	0	<1	463 **11%**	463	11
Perennial Streams	0	1 <1%	176 4%	0	0	0	0	177	4
Intermittent Streams	0	19 <1%	5 <1%	0	0	0	0	25	1
Wetland/ Water Totals	2,449	727	183	255	122	5	463	4,204	100
Area (%)	58	17	4	6	3	<1	11	21	
Uplands								15,923	79
Totals								20,128	100

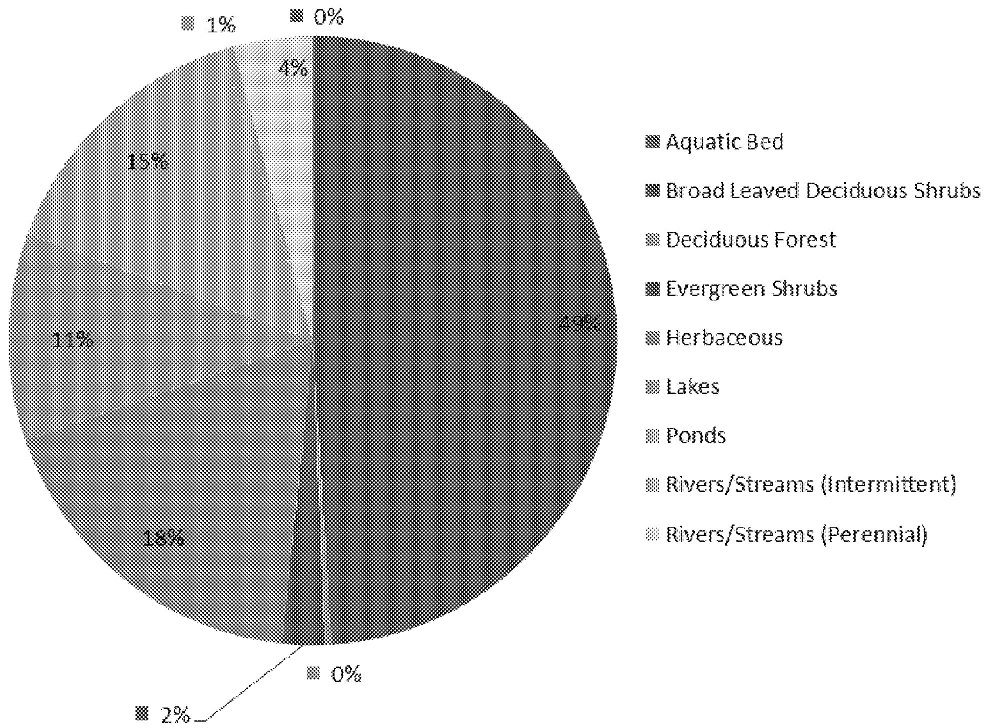
Notes:

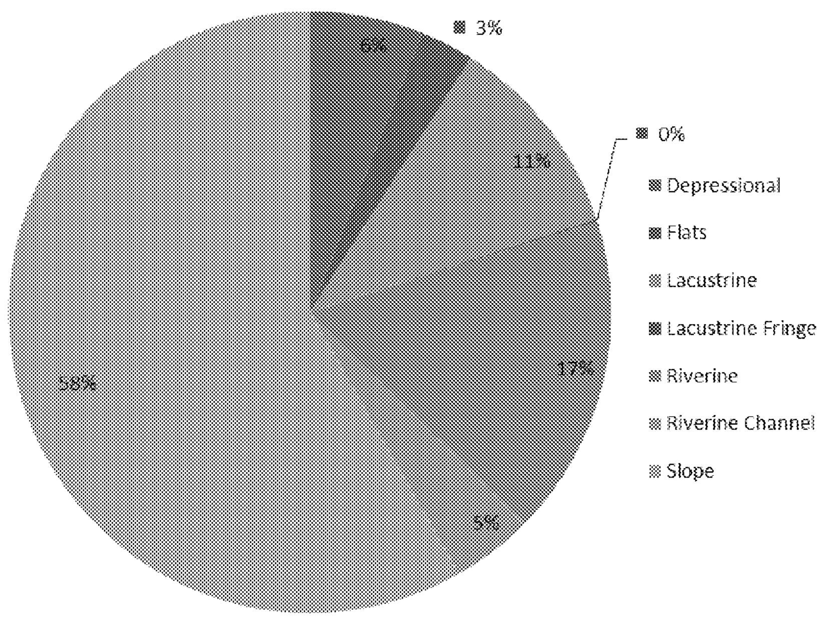
1 Includes percentage of all wetlands and waterbodies within the Mine Site mapping area.

2 The Mine Site mapping area overlaps with approximately 5 miles of the Transportation/Natural Gas Pipeline Corridor. That acreage is included here rather than in the Transportation/Natural Gas Pipeline Corridor mapping area.

Source: HDR 2018

Figure 3.22-12: NWI Groups and HGM Classes at the Transportation/Natural Gas Pipeline Corridor Mapping Area





3.22.6 Amakdedori Port Affected Environment

The mapping area for Amakdedori Port is approximately 3,973 acres. The proposed port would be located on the shore of Kamishak Bay, Cook Inlet, near Amakdedori Creek. It would include shore-based facilities to receive and store shipping containers and fuel, as well as power generation equipment, a natural gas compressor station, maintenance facilities, employee accommodations, and offices. Waterside improvements would consist of an earthen access causeway extending out to a marine dock. A dredged channel would follow a navigation route

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approximately 4.2 miles out to deep water. Dredged material would be stockpiled on uplands behind the marine terminal.

Marine waters make up the vast majority of the mapping area (86 percent) (Table 3.22-5). These are dominantly subtidal, deep water habitats. Cook Inlet has a very large tidal fluctuation, regularly reaching 25 feet or more. At low tide, areas of mud flats and cobble and gravel shores are exposed. These intertidal habitats make up approximately 1 percent of the mapping area.

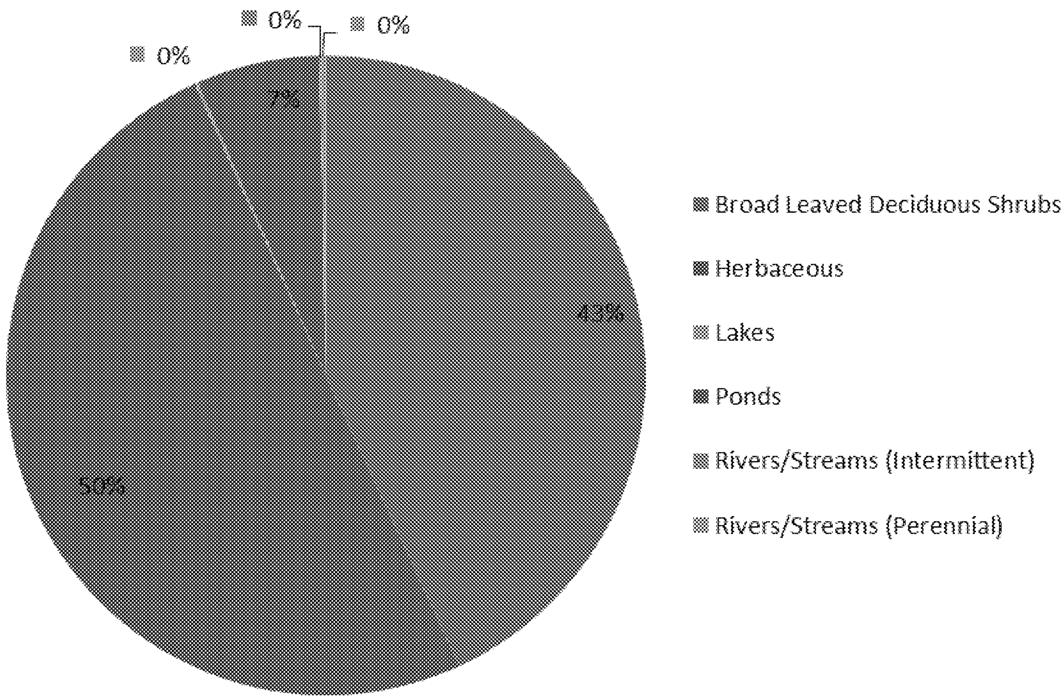
Vegetated wetlands account for only one percent of the mapping area, but nine percent of the non-marine habitats. Herbaceous and deciduous shrub wetlands make up approximately 50 percent and 43 percent, respectively, of the wetlands and waterbodies in the mapping area (Figure 3.22-13). Almost all (98 percent) of the wetlands and waterbodies were on the slope HGM class. Non-marine waterbodies include ponds and perennial and intermittent stream channels, which make up approximately 7 percent of the wetlands and waterbodies in the mapping area.

Table 3.22-5: Transportation/Natural Gas Pipeline Corridor Mapping Area Calculation of NWI Groups by HGM Classes

NWI Group	Area (acres)	Area (%)
Deciduous Shrub Wetlands	23	<1
Herbaceous Wetlands	26	<1
Ponds	3	<1
Lakes	<1	<1
Perennial Streams	<1	<1
Intermittent Streams	<1	<1
Marine Subtidal	3378	85
Marine Intertidal	44	1
Uplands	499	13
Total Area	3973	100
Wetland/ Water Totals	3474	87

Source: HDR 2018

Figure 3.22-13:Non-Marine NWI Groups at the Amakdedori Port Mapping Area



3.22.7 Natural Gas Pipeline Corridor Affected Environment – Kenai Peninsula/Cook Inlet

The mapping area for the Natural Gas Pipeline Corridor on the Kenai Peninsula and across Cook Inlet is approximately 377 acres. This includes a 30-foot wide corridor to account for temporary construction impacts. A buried steel pipeline, 10 to 12 inches in diameter, would connect to an existing pipeline near Happy Valley on the Kenai Peninsula, and run for approximately 10 miles along the Sterling Highway right-of-way to Cook Inlet. The pipeline would then cross the sea floor of Cook Inlet for approximately 94 miles to Amakdedori Port. Beginning at the port, the pipeline would be located within the Transportation/Natural Gas Pipeline Corridor, which is discussed above.

[Note: configuration of the pipeline on the Kenai Peninsula may change, pending project design updates.]

The pipeline mapping area is located within the Lower Kenai Peninsula watershed. This area includes permafrost-free, coastal lowlands with rolling glacial till and outwash plains. Cook Inlet is characterized by nearshore and deep water habitats with unconsolidated sediments on a smooth bottom and strong tidal currents. Numerous tributary basins with active glaciers contribute to high suspended sediment load in portions of Cook Inlet.

Ninety-one percent of the Natural Gas Pipeline Corridor mapping area occurs in marine waters of Cook Inlet, predominantly subtidal waters with an unconsolidated cobble-gravel bottom (M1UBL). The terrestrial portion of the mapping area is predominantly uplands; wetlands and streams cover approximately two acres (five percent). Broad leaved deciduous shrub wetlands (PSS1) in depressional geomorphic positions account for approximately one-half of the wetlands (Table 3.22-6, Figure 3.22-14). Forested wetlands on slopes are the second most abundant wetland type (25 percent). Waterbodies are limited to perennial stream channels (R2UB, R3UB).

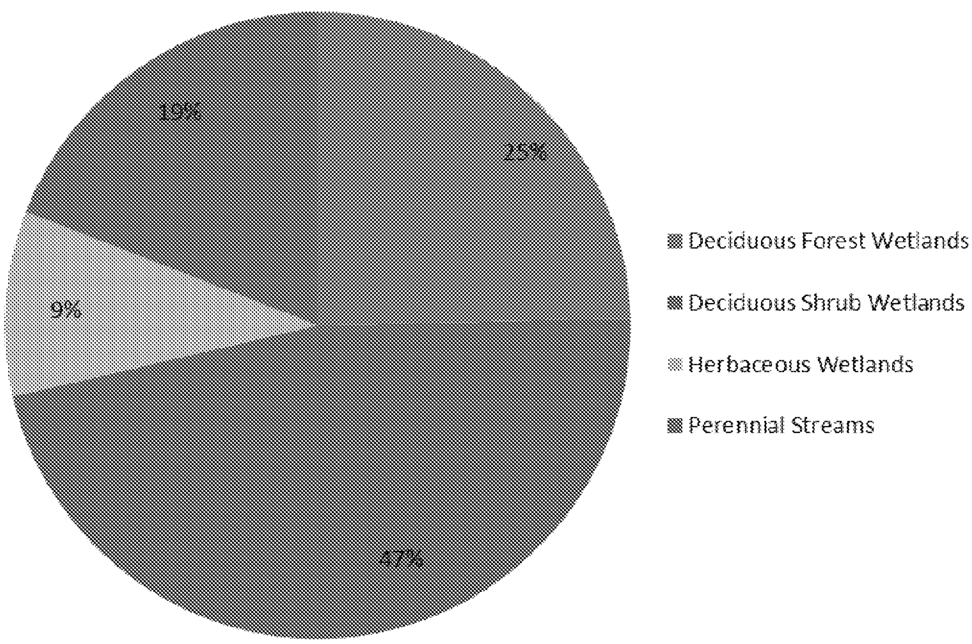
Human-caused soil or vegetation disturbance was not mapped for the pipeline corridor mapping area. Disturbance is expected to be common, given the location within the right-of-way of Sterling Highway.

Table 3.22-6: Natural Gas Pipeline Corridor Mapping Area (Kenai Peninsula/Cook Inlet) Calculation of Wetland Categories by HGM Classes

NWI Group	Area (acres)	Area (%)
Deciduous Forested Wetlands	<1	
Deciduous Shrub Wetlands	1	
Herbaceous Wetlands	<1	
Perennial Rivers & Streams	<1	
Intermittent Rivers & Streams	<1	
Marine Subtidal	341	
Marine Intertidal	<1	
Uplands	37	
Total Area	42	
Wetland/ Water Totals	342.86	

Source: HDR 2018

Figure 3.22-14:Non-Marine NWI Groups at the Natural Gas Pipeline Corridor Mapping Area (Kenai Peninsula/Cook Inlet)



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Sent: 6/5/2018 9:29:50 PM
To: Douglas, Mark [douglas.mark@epa.gov]
Subject: FW: draft Pebble EIS Outline).docx
Attachments: Pebble EIS Outline_2018.3.19 (002).docx

From: POA Special Projects [mailto:poaspecialprojects@usace.army.mil]
Sent: Tuesday, June 05, 2018 1:00 PM
To: Bob Loeffler <bobl@jadenorth.com>; Brooke Merrell <brooke_merrell@nps.gov>; Curyung Tribal <courtenay@curyungtribe.com>; 'cvaughn@achp.gov' <cvaughn@achp.gov>; Daugherty, Linda (PHMSA) <linda.daugherty@dot.gov>; David Seris (David.M.Seris@uscg.mil) <David.M.Seris@uscg.mil>; Douglass Cooper <douglass_cooper@fws.gov>; Hassell, David (PHMSA) <david.hassell@dot.gov>; John Eddins <jeddins@achp.gov>; Kevin Pendegast <kevin.pendergast@bsee.gov>; 'mary_colligan@fws.gov' <mary_colligan@fws.gov>; McCafferty, Katherine A CIV USARMY CEPOA (US) <Katherine.A.McCafferty2@usace.army.mil>; McCall, John <john.mccall@bsee.gov>; McGrath, Patricia <mcgrath.patricia@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>; Moselle, Kyle W (DNR) <kyle.moselle@alaska.gov>; Nathan Hill <manager@lakeandpen.com>; POA Special Projects <poaspecialprojects@usace.army.mil>; Pres William Evanoff <nondaltontribe@yahoo.com>; Wesley Furlong <wfurlong@narf.org>
Subject: draft Pebble EIS Outline).docx

FRONT MATTER

COVER SHEET

TITLE OF APPLICANT'S PROPOSED ACTION

IDENTIFICATION OF LEAD AND COOPERATING AGENCIES

NAME AND CONTACT INFORMATION FOR CORPS PGM

DESIGNATION OF DOCUMENT STATUS

ONE PARAGRAPH ABSTRACT TO BE WRITTEN BY CORP

COMMENT PERIOD

EXECUTIVE SUMMARY FOR FINAL EIS

SUMMARY OF THE EIS STRESSING MAJOR CONCLUSIONS, AREAS OF CONTROVERSY (INCLUDING ISSUES RAISED BY AGENCIES AND THE PUBLIC) AND ISSUES TO BE RESOLVED (INCLUDING THE CHOICES OF ALTERNATIVES(PREFERRED (APPENDIX B) AND LEDPA). TO BE WRITTEN AFTER DRAFT EIS IS COMPLETED AND PRIOR TO PUBLIC COMMENT PERIOD.

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3.14.4 Natural Gas Pipeline Corridor AE

3.14.4.1 Soil Types

3.14.4.2 Erosion

3.15 GEOHAZARDS (STATE OF ALASKA)

3.15.1 Mine Site AE

3.15.1.1 Earthquakes

3.15.1.2 Slope Stability

3.15.1.3 Other Geohazards

3.15.2 Amakdedori Port AE

3.15.2.1 Earthquakes

3.15.2.2 Slope Stability

3.15.2.3 Other Geohazards

3.15.3 Transportation Corridor AE

3.15.3.1 Earthquakes

3.15.3.2 Slope Stability

3.15.3.3 Other Geohazards

3.15.4 Natural Gas Pipeline Corridor AE

3.15.4.1 Earthquakes

3.15.4.2 Slope Stability

3.15.4.3 Other Geohazards

3.16 SURFACE WATER HYDROLOGY (EPA, STATE OF ALASKA)

3.16.1 Flood Hazards

3.16.2 Floodplain Values

3.16.3 Shore Erosion and Accretion

3.16.4 Salinity Gradients, Water Circulation, Fluctuation, Suspended Particulate and Turbidity

3.16.5 Mine Site AE

3.16.5.1 Drainage Basins/Watersheds

3.16.5.2 Streamflow

3.16.5.3 Meteorological Inputs to Water Balance Modeling

3.16.5.4 Flood Magnitude and Frequency

3.16.5.5 Surface Water Use

3.16.6 Amakdedori Port AE

3.16.6.1 Drainage Basins/Watersheds

3.16.6.2 Streamflow

3.16.6.3 Marine Water

3.16.6.4 Flood Magnitude and Frequency

3.16.6.5 Surface Water Use

3.16.7 Transportation Corridor AE

3.16.7.1 Drainage Basins/Watersheds

3.16.7.2 Streamflow

3.16.7.3 Surface Water Use

3.16.7.4 Surface Water Extraction Sites

3.16.7.5 Stream Crossing Bank Erosion/Scour)

3.16.8 Natural Gas Pipeline Corridor AE

3.16.8.1 Drainage Basins/Watersheds

3.16.8.2 Streamflow

3.16.8.3 Marine Water

3.16.8.4 Surface Water Use

3.16.8.5 Surface Water Extraction Sites

3.16.8.6 Stream Crossing Bank Erosion/Scour

3.17 GROUNDWATER HYDROLOGY (EPA, STATE OF ALASKA)

3.17.1 Water Supply and Conservation (Municipal and Private)

3.17.2 Hydrogeological Setting and Data Sources

3.17.3 Mine Site AE

3.17.3.1 Groundwater Occurrence and Aquifer Characteristics

3.17.3.2 Groundwater Quality and Use

3.17.3.3 Hydrogeologic Units

3.17.3.4 Groundwater Flow Systems

3.17.3.5 Aquifer Parameters: Hydraulic Conductivity and Specific Storage

3.17.3.6 Mine Site Groundwater Model

3.17.4 Amakdedori Port AE

3.17.4.1 Groundwater Occurrence and Aquifer Characteristics

3.17.4.2 Groundwater Quality and Use

3.17.5 Transportation Corridor AE

3.17.5.1 Groundwater Occurrence and Aquifer Characteristics

3.17.5.2 Groundwater Quality and Use

3.17.6 Natural Gas Pipeline Corridor AE

3.17.6.1 Groundwater Occurrence and Aquifer Characteristics

3.17.6.2 Groundwater Quality and Use

3.18 WATER AND SEDIMENT QUALITY (STATE OF ALASKA, EPA, USACE)

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3.18.2 Mine Site AE

3.18.2.1 Surface Water Quality

3.18.2.2 Groundwater Quality

3.18.2.3 Sediment Quality

3.18.2.4 Geochemistry

3.18.3 Amakdedori Port AE

3.18.3.1 Surface Water Quality

3.18.3.2 Groundwater Quality

3.18.3.3 Sediment Quality

3.18.4 Transportation Corridor AE

3.18.4.1 Surface Water Quality

3.18.4.2 Sediment Quality)

3.18.5 Natural Gas Pipeline Corridor AE

3.18.5.1 Surface Water Quality

3.18.5.2 Sediment Quality

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3.19.1 Applicable Noise Concepts (Terms, Sound Levels, Propagation, Health Effects)

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3.19.3 Amakdedori Port AE

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3.20 AIR QUALITY (STATE OF ALASKA)

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3.20.2 Air Quality Attainment Status

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3.21.2 Tailings Dam Failure Scenarios

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3.22.2 Wetlands/Special Aquatic Sites Analysis Methodology (Categories, Classes, Functions)

3.22.3 Mine Site AE

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3.22.6 Natural Gas Pipeline Corridor AE

3.23 WILDLIFE VALUES (NON-TES) (STATE OF ALASKA, FWS)

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3.23.1.1 Birds

3.23.1.2 Terrestrial Wildlife

3.23.2 Amakdedori Port AE

3.23.2.1 Birds

3.23.2.2 Terrestrial Wildlife

3.23.2.3 Marine Mammals

3.23.3 Transportation Corridor AE

3.23.3.1 Birds

3.23.3.2 Terrestrial Wildlife

3.23.3.3 Marine Mammals

3.23.4 Natural Gas Pipeline Corridor AE

3.23.4.1 Birds

3.23.4.2 Terrestrial Wildlife

3.23.4.3 Marine Mammals

3.24 FISH VALUES (STATE OF ALASKA, FWS)

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3.24.1.2 Resident and Anadromous Fish

3.24.1.3 Ecotoxicology Analysis

3.24.1.4 EFH

3.24.1.5 Aquatic Organisms Associated With the Food Web

3.24.2 Amakdedori Port AE

3.24.2.1 Aquatic Habitat

3.24.2.2 Resident and Anadromous Fish

3.24.2.3 Marine Fish

3.24.2.4 EFH

3.24.2.5 Aquatic Organisms Associated With the Food Web

3.24.3 Transportation Corridor AE

3.24.3.1 Aquatic Habitat

3.24.3.2 Resident and Anadromous Fish

3.24.3.3 EFH

3.24.3.4 Aquatic Organisms Associated With the Food Web

3.24.4 Natural Gas Pipeline Corridor

3.24.4.1 Aquatic Habitat

3.24.4.2 Resident and Anadromous Fish

3.24.4.3 EFH

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3.25.1.1 Cook Inlet Beluga Whale

3.25.1.2 Steller's Sea Lion

3.25.1.3 Northern Sea Otter

3.25.1.4 Fin Whale

3.25.1.5 Steller's Eider

3.25.1.6 Short Tailed Albatross

3.25.2 Transportation Corridor AE

3.25.2.1 Steller's Eider

3.25.3 Natural Gas Pipeline Corridor AE

3.25.3.1 Cook Inlet Beluga Whale

3.25.3.2 Steller's Sea Lion

3.25.3.3 Northern Sea Otter

3.25.3.4 Fin Whale

3.25.3.5 Steller's Eider

3.25.3.6 Short Tailed Albatross

3.26 VEGETATION (STATE OF ALASKA, EPA, USACE)

3.26.1 Mine Site AE

3.26.2 Amakdedori Port AE

3.26.3 Transportation Corridor AE

3.26.4 Natural Gas Pipeline Corridor AE

4.0 ENVIRONMENTAL CONSEQUENCES OF ACTION

4.1 IMPACT ASSESSMENT FRAMEWORK

4.2 TO 4.26 (SECTIONS REPEAT CHAPTER 3 ORDER)

5.0 MITIGATION AND MONITORING

5.1 INTRODUCTION

5.2 AVOIDANCE AND MINIMIZATION MEASURES UNDER NEPA

5.3 AVOIDANCE, MINIMIZATION, AND COMPENSATORY MITIGATION UNDER THE CLEAN WATER ACT

6.0 LIST OF PREPARERS

7.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE STATEMENT HAVE BEEN SENT

8.0 REFERENCES

9.0 APPENDICES

APPENDIX A – PUBLIC INVOLVEMENT

APPENDIX B – AGENCY COORDINATION

APPENDIX C – MAILING LIST

APPENDIX D – COMMENTS RECEIVED ON THE DEIS AND CORPS RESPONSES (FINAL)

APPENDIX E – PERMITS, APPROVALS, AND CONSULTATIONS REQUIRED

APPENDIX F – DRAFT CLEAN WATER ACTION 404(B)(1) ANALYSIS (IN DRAFT)

APPENDIX G – ESA BIOLOGICAL ASSESSMENT (FWS) (IN DRAFT)

APPENDIX H – ESA BIOLOGICAL ASSESSMENT (NMFS) (IN DRAFT)

APPENDIX I – EFH ASSESSMENT (IN DRAFT)

APPENDIX J – PJD

APPENDIX K – ETC., TECHNICAL APPENDICES

Appointment

From: Kelly, Christine M [kelly.christinem@epa.gov]
Sent: 6/5/2018 8:37:17 PM
To: Allnutt, David [Allnutt.David@epa.gov]; Anderson-Carnahan, Linda [Anderson-Carnahan.Linda@epa.gov]; McGrath, Patricia [mcgrath.patricia@epa.gov]; Palomaki, Ashley [Palomaki.Ashley@epa.gov]; Szerlog, Michael [Szerlog.Michael@epa.gov]; Steiner-Riley, Cara [Steiner-Riley.Cara@epa.gov]; LaCroix, Matthew [LaCroix.Matthew@epa.gov]; Vaughan, Molly [Vaughan.Molly@epa.gov]; Hough, Palmer [Hough.Palmer@epa.gov]; Marcia Combes (Combes.Marcia@epa.gov) [Combes.Marcia@epa.gov]; Mendelman, Krista [Mendelman.Krista@epa.gov]; Lindsay, Andrea [Lindsay.Andrea@epa.gov]; Skadowski, Suzanne [Skadowski.Suzanne@epa.gov]; Nogi, Jill [nogi.jill@epa.gov]; Peterson, Erik [Peterson.Erik@epa.gov]; Nalven, Heidi [Nalven.Heidi@epa.gov]; Fordham, Tami [Fordham.Tami@epa.gov]
CC: Douglas, Mark [douglas.mark@epa.gov]; Stern, Allyn [Stern.Allyn@epa.gov]

Subject: Bristol Bay Check-in
Location: R10Sea-Room-14Elwha/R10-Rooms-Service-Center **Conference Line/Code / Ex. 6**

Start: 6/12/2018 4:00:00 PM
End: 6/12/2018 5:00:00 PM
Show Time As: Tentative

Recurrence: Weekly
every 2 week(s) on Wednesday from 9:00 AM to 10:00 AM

Conference Line/Code / Ex. 6

Message

From: Vaughan, Molly [Vaughan.Molly@epa.gov]
Sent: 8/20/2018 3:47:29 PM
To: Douglas, Mark [douglas.mark@epa.gov]
Subject: FW: Pebble EIS: Preliminary Alternatives Screening for Aug 22; Comments by 8/31/2018
Attachments: 08_17_2018_Preliminary_Alternatives_Screening.pdf

Good morning, Mark. Here is the alternatives info.

-----Original Message-----
From: POA Special Projects [mailto:poaspecialprojects@usace.army.mil]
Sent: Friday, August 17, 2018 3:53 PM
To: bobl@jadenorth.com; Brooke Merrell <brooke_merrell@nps.gov>; Curyung Tribal <courtenay@curyungtribe.com>; 'cvaughn@achp.gov' <cvaughn@achp.gov>; Daugherty, Linda (PHMSA) <linda.daugherty@dot.gov>; David Seris (David.M.Seris@uscg.mil) <David.M.Seris@uscg.mil>; Douglass Cooper <douglass_cooper@fws.gov>; Hassell, David (PHMSA) <david.hassell@dot.gov>; Joan Kluwe <joan_kluwe@nps.gov>; John Eddins <jeddins@achp.gov>; Kevin Pendegast <kevin.pendergast@bsee.gov>; 'mary_colligan@fws.gov' <mary_colligan@fws.gov>; McCafferty, Katherine A CIV USARMY CEPOA (US) <Katherine.A.McCafferty2@usace.army.mil>; McCall, John <john.mccall@bsee.gov>; McGrath, Patricia <mcgrath.patricia@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>; Moselle, Kyle W (DNR) <kyle.moselle@alaska.gov>; manager@lakeandpen.com; POA Special Projects <poaspecialprojects@usace.army.mil>; nondaltontribe@yahoo.com; Wesley Furlong <wfurlong@narf.org>
Cc: POA Special Projects <poaspecialprojects@usace.army.mil>; Craig, Bill <bill.m.craig@aecom.com>
Subject: Pebble EIS: Preliminary Alternatives Screening for Aug 22; Comments by 8/31/2018

All,
Attached is the PRELIMINARY list of alternatives and the screening criteria used for considered by not analyzed in depth. This is the document we will discuss August 22, 2018 (1300-1500 AST). Please review for our meeting next wed. Please submit written comments by Friday 8/31/2018.

VR

Shane McCoy
Program Manager

Message

From: Smith, Marla J. [Smith.MarlaJ@epa.gov]
Sent: 7/26/2018 10:02:27 PM
To: Mendelman, Krista [Mendelman.Krista@epa.gov]
CC: Douglas, Mark [douglas.mark@epa.gov]
Subject: RE: Reimbursement - Mark Douglas

I think it will be fine.

Thank you.

From: Mendelman, Krista
Sent: Thursday, July 26, 2018 2:01 PM
To: Smith, Marla J. <Smith.MarlaJ@epa.gov>
Cc: Douglas, Mark <douglas.mark@epa.gov>
Subject: RE: Reimbursement - Mark Douglas

HI Marla,

I am working at home. Does this electronic signature work for you? It is an electronic signature constructed through Adobe and not my actual electronic signature but it works for me if it works for you. Let me know.

Krista

Krista Mendelman
US EPA Region 10 MS:OWW-193
1200 6th Ave. Suite 900
Seattle WA 98101
206-553-1571

From: Smith, Marla J.
Sent: Thursday, July 26, 2018 1:56 PM
To: Mendelman, Krista <Mendelman.Krista@epa.gov>
Cc: Douglas, Mark <douglas.mark@epa.gov>
Subject: Reimbursement - Mark Douglas
Importance: High

Hi Krista,

In order to get Mark Douglas reimbursed for his travel to the Pebble Mine, July 9 – July 11, we have to do a direct bill memo (see attached).

Please sign and scan/return to me so I can attach to his voucher.

Thank you,

Marla Smith
Management Analyst
EPA/Region 10
Alaska Operations Office
(907) 271-1272

Message

From: Mendelman, Krista [Mendelman.Krista@epa.gov]
Sent: 7/26/2018 10:01:19 PM
To: Smith, Marla J. [Smith.MarlaJ@epa.gov]
CC: Douglas, Mark [douglas.mark@epa.gov]
Subject: RE: Reimbursement - Mark Douglas
Attachments: M. Douglas - Reimbursement km.pdf

HI Marla,

I am working at home. Does this electronic signature work for you? It is an electronic signature constructed through Adobe and not my actual electronic signature but it works for me if it works for you. Let me know.

Krista

Krista Mendelman
US EPA Region 10 MS:OWW-193
1200 6th Ave. Suite 900
Seattle WA 98101
206-553-1571

From: Smith, Marla J.
Sent: Thursday, July 26, 2018 1:56 PM
To: Mendelman, Krista <Mendelman.Krista@epa.gov>
Cc: Douglas, Mark <douglas.mark@epa.gov>
Subject: Reimbursement - Mark Douglas
Importance: High

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Please sign and scan/return to me so I can attach to his voucher.

Thank you,

Marla Smith
Management Analyst
EPA/Region 10
Alaska Operations Office
(907) 271-1272

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
ALASKA OPERATIONS OFFICE
Room 537, Federal Building
222 W. 7th Avenue, #19
Anchorage, AK 99513-7588

July 26, 2018

MEMORANDUM

SUBJECT: Request for Reimbursement of Airfare/Lodging paid for with personal check

FROM: Mark Douglas
Environmental Scientist

THRU: Krista Mendelman Krista L Mendelman
Unit Manager, Aquatic Resources Unit
Office of Environmental Review and Assessment

TO: Gregory Luebbering
Supervisory Accountant, CFC

I am requesting reimbursement in the amount of $1,434.00 for airfare and lodging (which includes meals) to Iliamna and the Pebble Mine site for 07/09/18 - 07/11/18, paid for by personal check.

The Pebble Partnership does not allow just any flight service to fly out to the mine site. The have a contract for air services with specific vendors and make those arrangements for travelers.

Lodging is extremely limited in Iliamna. the Pebble Partnership has an agreement with certain lodges to provide lodging and meals to folks coming out there.

The Pebble Partnership is not set up to take credit cards (personal or government). The only option for payment is by personal check or cash.

Message

From: Smith, Marla J. [Smith.MarlaJ@epa.gov]
Sent: 7/26/2018 8:56:00 PM
To: Mendelman, Krista [Mendelman.Krista@epa.gov]
CC: Douglas, Mark [douglas.mark@epa.gov]
Subject: Reimbursement - Mark Douglas
Attachments: M. Douglas - Reimbursement.pdf

Importance: High

Hi Krista,

In order to get Mark Douglas reimbursed for his travel to the Pebble Mine, July 9 – July 11, we have to do a direct bill memo (see attached).

Please sign and scan/return to me so I can attach to his voucher.

Thank you,

Marla Smith
Management Analyst
EPA/Region 10
Alaska Operations Office
(907) 271-1272

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
ALASKA OPERATIONS OFFICE
Room 537, Federal Building
222 W. 7th Avenue, #19
Anchorage, AK 99513-7588

July 26, 2018

MEMORANDUM

SUBJECT: Request for Reimbursement of Airfare/Lodging paid for with personal check

FROM: Mark Douglas
Environmental Scientist

THRU: Krista Mendelman
Unit Manager, Aquatic Resources Unit
Office of Environmental Review and Assessment

TO: Gregory Luebbering
Supervisory Accountant, CFC

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Message

From: Vaughan, Molly [Vaughan.Molly@epa.gov]
Sent: 7/26/2018 5:05:33 PM
To: Douglas, Mark [douglas.mark@epa.gov]
Subject: FW: Revised comment date for Chapter 3 and 4 sections to 31 August 2018

Hi Mark -- wanted to share this with you right away since I know you are scrambling to complete your review of the Ch. 4 sections. I'll also discuss at today's Pebble team meeting, and provide an updated internal due date a couple weeks out (after I've had a chance to look at the calendar and talk to Patty).

-----Original Message-----
From: POA Special Projects [mailto:poaspecialprojects@usace.army.mil]
Sent: Thursday, July 26, 2018 8:45 AM
To: bobl@jadenorth.com; Brooke Merrell <brooke_merrell@nps.gov>; Curyung Tribal <courtenay@curyungtribe.com>; 'cvaughn@achp.gov' <cvaughn@achp.gov>; Daugherty, Linda (PHMSA) <linda.daugherty@dot.gov>; David Seris (David.M.Seris@uscg.mil) <David.M.Seris@uscg.mil>; Douglass Cooper <douglass_cooper@fws.gov>; Hassell, David (PHMSA) <david.hassell@dot.gov>; Joan Kluwe <joan_kluwe@nps.gov>; John Eddins <jeddins@achp.gov>; Kevin Pendegast <kevin.pendergast@bsee.gov>; 'mary_colligan@fws.gov' <mary_colligan@fws.gov>; McCafferty, Katherine A CIV USARMY CEPOA (US) <Katherine.A.McCafferty2@usace.army.mil>; McCall, John <john.mccall@bsee.gov>; McGrath, Patricia <mcgrath.patricia@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>; Moselle, Kyle W (DNR) <kyle.moselle@alaska.gov>; manager@lakeandpen.com; POA Special Projects <poaspecialprojects@usace.army.mil>; nondaltontribe@yahoo.com; Wesley Furlong <wfurlong@narf.org>
Cc: Hobbie, David S CIV USARMY CEPOA (US) <David.S.Hobbie@usace.army.mil>; Newman, Sheila M CIV USARMY CEPOA (US) <Sheila.M.Newman@usace.army.mil>
Subject: Revised comment date for Chapter 3 and 4 sections to 31 August 2018

Cooperating Agencies,

Last week it came to my attention that I inadvertently omitted to distribute some sections of draft Chapters 3 and 4 to some cooperators. I had originally asked that cooperators submit comments on these draft chapters by 31 July for Chapter 4 and July 5 for comments for Chapter 3.

Given my oversight, I am now asking that the review for both Chapters 3 and 4 sections be submitted by August 31, 2018. This will also mean that the robust technical discussions will occur in October.

I would like to remind everyone, that at this stage of the development of the analysis, I am asking that your review be at a high level; meaning that we are asking your teams to identify gaps (did we miss something?). The team developing the sections will review the comments and may be reaching out to you for clarity. A more in detail review will be expected in October when the team has incorporated additional information based on your input and data gathered by the teams.

As we are all aware, there are many moving parts to any EIS and it is difficult to keep all things on track. I would greatly appreciate any issues being brought directly to my attention as soon as you identify them. Please email me or call me directly if you have concerns or questions about the flow of information so we can collaboratively ensure that errors are caught and corrected as soon as possible.

VR

Shane McCoy
Program Manager
907-753-2715

Message

From: Smith, Marla J. [Smith.MarlaJ@epa.gov]
Sent: 7/25/2018 7:00:35 PM
To: Douglas, Mark [douglas.mark@epa.gov]
Subject: RE: Invoice from PLP

Glad you were able to get that.

From: Douglas, Mark
Sent: Wednesday, July 25, 2018 10:21 AM
To: Smith, Marla J. <Smith.MarlaJ@epa.gov>; Niemiec, Maria J. <niemiec.maria@epa.gov>
Subject: Invoice from PLP

Passing this along, I'll submit the paperwork in the morning when I am back at the office.

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

Appointment

From: McGrath, Patricia [mcgrath.patricia@epa.gov]
Sent: 7/25/2018 6:55:33 PM
To: Vaughan, Molly [Vaughan.Molly@epa.gov]; LaCroix, Matthew [LaCroix.Matthew@epa.gov]; Meade, Christopher [Meade.Chris@epa.gov]; Godsey, Cindi [Godsey.Cindi@epa.gov]; Pepple, Karl [Pepple.Karl@epa.gov]; McAlpine, Jerrold [McAlpine.Jay@epa.gov]; Palomaki, Ashley [Palomaki.Ashley@epa.gov]; Wake, Neverley [wake.neverley@epa.gov]; Hough, Palmer [Hough.Palmer@epa.gov]; Maley, Timothy [maley.timothy@epa.gov]; Eckley, Chris [Eckley.Chris@epa.gov]
CC: Douglas, Mark [douglas.mark@epa.gov]; Schofield, Kate [Schofield.Kate@epa.gov]; Thiesing, Mary [Thiesing.Mary@epa.gov]

Subject: Pebble permit oversight/NEPA team
Location: R10Sea-Room-14Elwha/R10-Rooms-Service-Center

Start: 7/26/2018 8:00:00 PM
End: 7/26/2018 9:00:00 PM
Show Time As: Tentative

Recurrence: Monthly
the fourth Thursday of every 1 month(s) from 1:00 PM to 2:00 PM

Conference Line/Code / Ex. 6

Monthly Pebble permit oversight/NEPA team meeting
Agenda below, please feel free to suggest additional agenda topics

Agenda:

- Review of preliminary EIS sections – Molly
- Field verification site visit – Mark
- Upcoming agency meetings – Patty
- Schedule - Patty

Message

From: Maley, Timothy [maley.timothy@epa.gov]
Sent: 6/26/2018 4:51:40 PM
To: Vaughan, Molly [Vaughan.Molly@epa.gov]; McGrath, Patricia [mcgrath.patricia@epa.gov]; Godsey, Cindi [Godsey.Cindi@epa.gov]; Pepple, Karl [Pepple.Karl@epa.gov]; McAlpine, Jerrold [McAlpine.Jay@epa.gov]; Palomaki, Ashley [Palomaki.Ashley@epa.gov]; Wake, Neverley [wake.neverley@epa.gov]; Hough, Palmer [Hough.Palmer@epa.gov]; Schofield, Kate [Schofield.Kate@epa.gov]; Eckley, Chris [Eckley.Chris@epa.gov]; Barton, Justine [Barton.Justine@epa.gov]; Douglas, Mark [douglas.mark@epa.gov]; Muche, Muluken [Muche.Muluken@epa.gov]
Subject: RE: REVIEW REQUEST and additional documents loaded to Sharepoint
Attachments: TM Comments on PreDraft Sec3.17 HydroGeo 6-25-18.docx; TM Comments on PreDraft Sec3.18 WaterQuality and GeoChem 6-25-18.docx

Hi Molly,

Attached are my comments on Sections 3.17 and 3.18.

Let me know if you have questions or need follow up information.

- Tim

Tim Maley, PG
EPA-R10/OERA
O: 206-553-1210

From: Vaughan, Molly
Sent: Thursday, June 7, 2018 12:13 PM
To: McGrath, Patricia <mcgrath.patricia@epa.gov>; Godsey, Cindi <Godsey.Cindi@epa.gov>; Pepple, Karl <Pepple.Karl@epa.gov>; McAlpine, Jerrold <McAlpine.Jay@epa.gov>; Palomaki, Ashley <Palomaki.Ashley@epa.gov>; Wake, Neverley <wake.neverley@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>; Schofield, Kate <Schofield.Kate@epa.gov>; Maley, Timothy <maley.timothy@epa.gov>; Eckley, Chris <Eckley.Chris@epa.gov>; Barton, Justine <Barton.Justine@epa.gov>; Douglas, Mark <douglas.mark@epa.gov>; Muche, Muluken <Muche.Muluken@epa.gov>
Subject: REVIEW REQUEST and additional documents loaded to Sharepoint

Hello Team,
The Corps distributed some additional information to cooperating agencies related to yesterday's Cooperating Agency meeting here in Anchorage, and I have added these materials to the Sharepoint site, in the "Materials for 6-6-18 Cooperating Agency Meeting" folder. Most of the information is for awareness only, but our review has been requested on two items:

1) the Preliminary Scoping Report

Internal Website/ Ex. 6

2) selected sections of Pre-Draft Chapter 3

Internal Website/ Ex. 6

Your review is being requested on specific materials (listed below), but feel free to also review the remainder of the materials if you wish.

- Preliminary Scoping Report: **Molly/Patty** – comments due to Molly **June 20**

This document addresses scoping comments received to date, but will be updated following the close of the public scoping period.

- Pre-Draft Chapter 3 Sections – comments due to Molly **June 25** (specific section assignments below)
  These documents are first drafts of each resource section Affected Environment, and will also be updated following the close of public scoping and based on cooperating agency input. It is not clear whether cooperators will have an opportunity to review a second iteration prior to publication of the Draft EIS, so a thorough review at this stage is critical.

  The Corps has requested that our review focus on what is missing or any inaccuracies (don't worry about formatting, grammar, etc.). Where we identify something missing/innacurate, we are asked to be very specific in our recommendation. If you identify missing information in your review, first check the RFIs and Responses to Date

  Internal Website/ Ex. 6

  If there is a RFI/response that addresses your concern, then please note that in your comment. If not, then please include in your comment: (1) the information gap, (2) a reference where additional information can be found, and (3) what from that reference should be added, with as much specificity as possible – suggested text would be helpful.

  Please identify the sub-section and page number for each of your comments.

  Here are specific assignments for the review request. Most sections include a word document as well as some associated figures in pdf form.
- 3.1 Intro – **Molly**
- 3.5 Recreation – **Mark/Palmer/Molly**
- 3.11 Aesthetics – **Mark/Palmer/Molly**
- 3.14 Soils – **Mark/Palmer**
- 3.16 Surface Water Hydrology (note, we received figures but not text, and are following up) – **Tim/Mark/Palmer/Muluken**
- 3.17 Groundwater Hydrology – **Tim/Mark/Palmer/Muluken**
- 3.18 Water and Sediment Quality – **Cindi/Tim/Chris**
- 3.22 Wetlands/ Special Aquatic Sites – **Mark/Palmer**
- 3.26 Vegetation (note, we received figures but not text, and are following up) – **Mark/Palmer**

Please let me know if you have any questions. Thank you for your assistance with this review.
Regards,
Molly

~~~~~~
Molly Vaughan
U.S. Environmental Protection Agency Region 10
Alaska Operations Office
222 W. 7th Avenue #19
Anchorage, AK 99513-7588

907-271-1215
vaughan.molly@epa.gov
~~~~~~

From: Vaughan, Molly
Sent: Thursday, May 24, 2018 2:47 PM
To: McGrath, Patricia <mcgrath.patricia@epa.gov>; Meade, Christopher <Meade.Chris@epa.gov>; Godsey, Cindi <Godsey.Cindi@epa.gov>; Pepple, Karl <Pepple.Karl@epa.gov>; McAlpine, Jerrold <McAlpine.Jay@epa.gov>; Palomaki, Ashley <Palomaki.Ashley@epa.gov>; Wake, Neverley <wake.neverley@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>; Schofield, Kate <Schofield.Kate@epa.gov>; Maley, Timothy <maley.timothy@epa.gov>; Eckley, Chris <Eckley.Chris@epa.gov>; Barton, Justine <Barton.Justine@epa.gov>; Douglas, Mark <douglas.mark@epa.gov>
Subject: RE: Pebble NEPA/permitting team - documents for awareness review

Hi All,
All of the materials received from the Corps to date are now on the Sharepoint site, in a folder labeled "Materials for 6-6-18 Cooperating Agency Meeting," for your perusal if interested.

Internal Website/ Ex. 6

Regards,
Molly

From: McGrath, Patricia
Sent: Friday, May 18, 2018 11:29 AM
To: Vaughan, Molly <Vaughan.Molly@epa.gov>; LaCroix, Matthew <LaCroix.Matthew@epa.gov>; Meade, Christopher <Meade.Chris@epa.gov>; Godsey, Cindi <Godsey.Cindi@epa.gov>; Pepple, Karl <Pepple.Karl@epa.gov>; McAlpine, Jerrold <McAlpine.Jay@epa.gov>; Palomaki, Ashley <Palomaki.Ashley@epa.gov>; Wake, Neverley <wake.neverley@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>; Schofield, Kate <Schofield.Kate@epa.gov>; Maley, Timothy <maley.timothy@epa.gov>; Eckley, Chris <Eckley.Chris@epa.gov>; Barton, Justine <Barton.Justine@epa.gov>; Douglas, Mark <douglas.mark@epa.gov>
Subject: Pebble NEPA/permitting team - documents for awareness review

Pebble NEPA/permitting team –

The Corps has started sending us, and other cooperating agencies, information generated by PLP and the third-party EIS contractor (AECOM). This information includes AECOM's requests (to PLP) for additional information (RFAIs) and PLP's responses. The Corps has begun adding theses RFAIs to the public EIS website. Molly and I will add this information to our SharePoint site as well.
The Corps has submitted this information to us and requested an awareness review, but is not requesting written comments.

For now, I want to bring your attention to two documents, attached:
1 – PLP Updates to the Proposed Project - PLP has made some updates to the project description. Please review this document so that you are aware of the changes. Some of these changes could impact parts of our scoping letter (e.g., use of lightering and elimination of dredging).
2 – PLP Technical Note on Project Options and Screening Criteria – This document summarizes screening criteria and options used by PLP to develop its current project description. I expect the Corps will consider this information during alternatives development. Please review this document for awareness.

We will discuss these documents during our next team meeting on May 24, and I can provide more context. In the meantime, please let me know if you have questions.

Thanks-
Patty

Patty McGrath |Mining Advisor
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Seattle, WA 98101
M/S: RAD-202
Office: (206) 553-6113
Cell: (206) 743-7068
mcgrath.patricia@epa.gov

Clear Form

THE pebble PARTNERSHIP

2017 SITE SERVICES REQUEST FORM

Two weeks advance notice is required prior to all site visits

DATE OF REQUEST: 6/6/2018		*For PLP Use only* Purchase Order #: ___10ANC09 ___20SIT09 ___30ENG09 ___40ENV09 ___50BD09 ___50PA09 ___50SR09 ___50WF09
PROJECT LEADER: Mark Douglas	CATEGORY/TASK # Wetlands	
COMPANY: US EPA		
CONTACT PHONE/EMAIL: Douglas.Mark@epa.gov		

FLIGHT DETAILS: ALL FLIGHTS TO SITE MUST BE BOOKED THROUGH sitetravel@pebblepartnership.com

From/To	Airline	Date	Flight	Time
ANC/ILI	IAT	07/09/18		AM
ILI/ANC	IAT	07/11/18		PM

However, if arrangements are in place please provide details below

Names of Individuals in Group:	Affiliation	M	F	Special Dietary Requests / Food Allergies
1. Mark Douglas	USACE	◉	○	
2.		◉	○	
3.		◉	○	
4.		◉	○	
5.		○	○	
6.		○	○	
7.		○	○	
8.		○	○	
9.		○	○	
10.		○	○	

Purpose of Visit:

Wetlands field work

Scope of Work:

Field verification of mosaic wetlands with HDR wetlands crews.

Comments:

EPA staff will coordinate with USACE & HDR wetlands scientists to determine sites that will be visited and configuration of each field crew. All work will be conducted in the mine site/deposit area and will be based out of Iliamna.

THE pebble PARTNERSHIP

ADDITIONAL REQUIREMENTS		
Private Land Access:	**# People:**	**Dates:**
☐ APC		
☐ CIRI		
☐ INL		
☐ PBC		
☐ KIJIK		
☐ Other *(describe)*:		
Labor:	**# People:**	**Dates:**
☑ Bear Guard	1*	7/9-7/11
☐ Observer		
☐ Laborer		
☐ Local Knowledge Specialist		
☐ Other *(describe)*:		
Helicopter:	**# People:**	**#Hours/Day:**
☐		
☑ ASTAR	1*	Full
☐ 500		
☐ R44		
Other:	**Quantity:**	**Dates:**
☐ Boat *(describe)*:		
☐ Backhoe		
☐ Vehicle		
☐ Bicycle		

Comments:

Please arrange for individual rooms for EPA staff.
*Helicopter and bear guard needs should be coordinated with USACE/HDR request for the same days.

TO BE COMPLETED BY THE REQUESTING TRAVELER
Date: 6/14/18 Signature:

TO BE COMPLETED BY AUTHORIZING SUPERVISOR
Date: Signature:
Printed Name:

TO BE COMPLETED BY PERSON COMPLETING TRAVEL ARRANGEMENTS
Date Received: Date Completed:
Signature of person completing travel arrangements:
☐ Emailed to PLP Invoicing ☐ Emailed to traveler ☐ Faxed to traveler

PLEASE ATTACH MAPS AS THEY RELATE TO THE SCOPE OF WORK.

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 6/15/2018 12:30:32 AM
To: Mendelman, Krista [Mendelman.Krista@epa.gov]; Thiesing, Mary [Thiesing.Mary@epa.gov]
CC: Smith, Marla J. [Smith.MarlaJ@epa.gov]; McGrath, Patricia [mcgrath.patricia@epa.gov]
Subject: Pebble Request form
Attachments: MD Pebble Site visit form.pdf

Krista or Mary Anne,

Attached is the form Pebble sent for the site visit in July. Please sign it and send it back **Personal Matters / Ex. 6** but if you are able to sign it on Friday **Personal Phone / Ex. 6** to let me know it's ready and I'll log in and send it on to Pebble.

Thanks!

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

Message

From:	Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent:	11/19/2018 8:13:01 PM
To:	Vaughan, Molly [Vaughan.Molly@epa.gov]
Subject:	RE: Pebble Draft Ch 2 comments for review

Molly,

I'd suggest **Deliberative Process / Ex. 5**

Thanks as always,

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

From: Vaughan, Molly
Sent: Monday, November 19, 2018 10:35 AM
To: Douglas, Mark <douglas.mark@epa.gov>
Subject: FW: Pebble Draft Ch 2 comments for review

Hi Mark – please take a look at Ashley's edits to the first comment in the table, also described in her email below, and let me know how you would like to finalize the comment.
Thanks,
Molly

From: Palomaki, Ashley
Sent: Monday, November 19, 2018 8:01 AM
To: McGrath, Patricia <mcgrath.patricia@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>
Subject: RE: Pebble Draft Ch 2 comments for review

Hi Molly –

Thanks for the opportunity to review. My comments are attached. I have a problem in that I always fix nits if I see them ☺ but you should take it or leave it. I also flagged a couple places for you where you should edit the sentence b/c it isn't clear.

Attorney Client Privilege/Deliberative Process Privilege / Ex. 5

Ashley

Ashley Palomaki
Assistant Regional Counsel
U.S. EPA Region 10 Office of Regional Counsel
1200 Sixth Avenue, Suite 155, ORC-113
Seattle, WA 98101
206-553-8582

From: McGrath, Patricia
Sent: Friday, November 16, 2018 9:25 AM
To: Vaughan, Molly <Vaughan.Molly@epa.gov>; Palomaki, Ashley <Palomaki.Ashley@epa.gov>
Subject: RE: Pebble Draft Ch 2 comments for review

Hi Molly and Ashely –
Can you please consider my proposed revision to the introductory paragraph? Deliberative Process / Ex. 5
Deliberative Process / Ex. 5

Deliberative Process / Ex. 5

From: Vaughan, Molly
Sent: Thursday, November 15, 2018 3:52 PM
To: Palomaki, Ashley <Palomaki.Ashley@epa.gov>
Cc: McGrath, Patricia <mcgrath.patricia@epa.gov>
Subject: Pebble Draft Ch 2 comments for review

Hi Ashley,
I am so sorry for the delay in getting these comments to you for review. If you will no longer be able to complete your review Friday, please let me know. I also apologize that some of the comments (particularly the last couple pages) are still a bit rough. So, please don't feel that you have to edit grammar, punctuation, etc., as I will do another read-through for that before sending this to Jill.

Patty – I've copied you here as well, so you can decide if you would prefer to do your final review of the compiled comments now, or at the same time as Jill's review.

Thank you very much in advance for your review!
--Molly

~~~~~~
Molly Vaughan
U.S. Environmental Protection Agency Region 10
Alaska Operations Office
222 W. 7th Avenue #19
Anchorage, AK 99513-7588

907-271-1215
vaughan.molly@epa.gov
~~~~~~

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 11/9/2018 8:54:17 PM
To: Vaughan, Molly [Vaughan.Molly@epa.gov]
Subject: Chapter 2 comments
Attachments: Ch 2 Pebble comments.docx

Molly,

Deliberative Process / Ex. 5

Thanks,

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 6/7/2018 6:22:59 PM
To: Mendelman, Krista [Mendelman.Krista@epa.gov]
Subject: RE: Pebble Trip

Perfect, thanks.

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

From: Mendelman, Krista
Sent: Thursday, June 07, 2018 10:22 AM
To: Douglas, Mark <douglas.mark@epa.gov>
Subject: RE: Pebble Trip

Sure! I have a meeting at 11:30 that I need to get ready for. I will call you after that is done. 12:00ish my time.

Krista

Krista Mendelman
US EPA Region 10 MS:OWW-193
1200 6th Ave. Suite 900
Seattle WA 98101
206-553-1571

From: Douglas, Mark
Sent: Thursday, June 07, 2018 11:21 AM
To: Mendelman, Krista <Mendelman.Krista@epa.gov>
Subject: Pebble Trip

Krista,

Can you call me when you get a chance?

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency

Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 6/7/2018 3:55:22 PM
To: Smith, Marla J. [Smith.MarlaJ@epa.gov]; McGrath, Patricia [mcgrath.patricia@epa.gov]
CC: Mendelman, Krista [Mendelman.Krista@epa.gov]
Subject: FW: Field Logistics

First of 2 emails for Pebble site visit logistics. The Corps informed me the flight they are taking over to Iliamna is apparently full so I'll have to find my way over there in time and the description of helicopter use and cost in the second email seems open ended.

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

-----Original Message-----
From: Campellone, Estrella F CIV USARMY CEPOA (US) [mailto:Estrella.F.Campellone@usace.army.mil]
Sent: Wednesday, June 06, 2018 4:19 PM
To: Douglas, Mark <douglas.mark@epa.gov>
Subject: FW: Field Logistics

Hi Mark,

Our arrangements:
Iliamna Air Taxi Inc:
Arrival time @ Iliamna: July 9 (Monday) at 0900.
Departure time: July 11 @ 4:30 p.m.

Corps will disburse the company directly for hotel/helicopter costs.
Hotel:
Check in July 9th
Check out July 11th

Meals:
July 9th (- Diner)
July 10th (all meals)
July11th (breakfast & lunch).

Rooms are reserve through Tim Harvey:
Meals are cafeteria style. For our arrival day, we will bring our lunch. For the remaining days they will make a bag lunch at breakfast to bring with us to the field.

Company will provide in-town transportation to/from the airport each day in one of their vehicles. Work days are 12 hours, with 10 in the field and one hour on either end for muster, briefings, etc. Crews normally do not return to base during the work day unless weather limits flight operations. Low clouds and/or high winds are typically the only conditions that will restrict helicopter travel.

No firearms are permitted at any Pebble facility or in helicopters. Trained bear guards will be provided with each crew. Guards are in constant radio contact with site operations. Alcohol is prohibited at any Pebble facility.

Safety training and site orientation will take place as soon as we arrive. That should take about an hour, followed by a 20-minute helicopter safety briefing. They provide basic PPE (safety goggles, high visibility vest, hearing protection). You are welcome to bring your own as long as the operations manager approves. Field gear requirements are what we would normally bring.

Accommodations are 150/person/day. They will invoice you after your trip. their site staff does not have the ability to accept payments. Helicopter time will likewise be invoiced to you based on the per seat cost and number of flight hours logged. Cost may vary depending on which helicopter is available.

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 10/31/2018 10:19:41 PM
To: Chu, Rebecca [Chu.Rebecca@epa.gov]
Subject: FW: Bristol Bay - Pebble Limited Partnership 10/17/18 Letter to EPA
Attachments: 19-000-0691_(FYI).Correpsondence.Collier.pdf; 19-000-0691_Control Slip..pdf

FYI

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

From: Vaughan, Molly
Sent: Wednesday, October 31, 2018 10:01 AM
To: Wake, Neverley <wake.neverley@epa.gov>; Godsey, Cindi <Godsey.Cindi@epa.gov>; Pepple, Karl <Pepple.Karl@epa.gov>; McAlpine, Jerrold <McAlpine.Jay@epa.gov>; Palomaki, Ashley <Palomaki.Ashley@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>; Maley, Timothy <maley.timothy@epa.gov>; Eckley, Chris <Eckley.Chris@epa.gov>; Butler, Barbara <Butler.Barbara@epa.gov>; Douglas, Mark <douglas.mark@epa.gov>; Schofield, Kate <Schofield.Kate@epa.gov>; Thiesing, Mary <Thiesing.Mary@epa.gov>; Muche, Muluken <muche.muluken@epa.gov>; Barton, Justine <Barton.Justine@epa.gov>
Cc: McGrath, Patricia <mcgrath.patricia@epa.gov>
Subject: FYI: Bristol Bay - Pebble Limited Partnership 10/17/18 Letter to EPA

FYI Pebble NEPA Team – the attached letter may be of interest as it pertains to the NEPA process for the project.
--Molly

From: Allnutt, David
Sent: Tuesday, October 30, 2018 2:10 PM
To: Nogi, Jill <nogi.jill@epa.gov>; Vaughan, Molly <Vaughan.Molly@epa.gov>
Subject: FW: Bristol Bay - Pebble Limited Partnership 10/17/18 Letter to EPA

Seeing now that this did not go to you. Please share with the Pebble NEPA team as appropriate.

R. David Allnutt, Director
Office of Environmental Review and Assessment
U.S. EPA, Region 10
1200 Sixth Avenue, Suite 155
Seattle, Washington 98101-3140
(206) 553-2581

From: Peterson, Erik
Sent: Monday, October 29, 2018 1:12 PM
To: Allnutt, David <Allnutt.David@epa.gov>; McGrath, Patricia <mcgrath.patricia@epa.gov>
Cc: Steiner-Riley, Cara <Steiner-Riley.Cara@epa.gov>; Nalven, Heidi <Nalven.Heidi@epa.gov>; Wehling, Carrie <Wehling.Carrie@epa.gov>; Palomaki, Ashley <Palomaki.Ashley@epa.gov>; Bennett, Brittany <bennett.brittany@epa.gov>; Ortiz, Michael <Ortiz.Michael@epa.gov>; Skadowski, Suzanne <Skadowski.Suzanne@epa.gov>; Lindsay, Andrea <Lindsay.Andrea@epa.gov>; Whitley, Annie <Whitley.Annie@epa.gov>; Wake, Neverley <wake.neverley@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>
Subject: Bristol Bay - Pebble Limited Partnership 10/17/18 Letter to EPA

FYI – See attached letter from PLP.

Erik Peterson, NEPA Reviewer
U.S. EPA, Region 10
1200 Sixth Avenue, Suite 155
Seattle, Washington 98101-3140
(206) 553-6382

From: Kelly, Christine M
Sent: Monday, October 29, 2018 1:04 PM
To: Peterson, Erik <Peterson.Erik@epa.gov>
Subject: Incoming CMS 19-000-0691 (FYI)

Erik,
Please find attached the FYI CMS that came in on Friday.

Christine Kelly
EPA- Region 10
206-553-2770

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 6/6/2018 6:10:23 PM
To: Mendelman, Krista [Mendelman.Krista@epa.gov]
Subject: FW: Travel requests

Krista,

Sorry for the additional email – I did update the Pebble related trip in the spreadsheet as well. It appears to be ARE funds set aside. Hopefully Patty will be able to find out the anticipated schedule today for the site visit this summer.

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

From: Douglas, Mark
Sent: Wednesday, June 06, 2018 9:37 AM
To: Mendelman, Krista <Mendelman.Krista@epa.gov>
Subject: RE: Travel requests

Krista,

Minutes before the start of the Pebble meeting and while walking out the door, I was informed the Corps wasn't allowing me to participate in the meeting. The attendees are limited to the primary contacts.

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Thanks,

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office

222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

From: Mendelman, Krista
Sent: Wednesday, June 06, 2018 7:41 AM
To: Douglas, Mark <douglas.mark@epa.gov>
Subject: RE: Travel requests

Sure.

Krista

____

Krista Mendelman
US EPA Region 10 MS:OWW-193
1200 6th Ave. Suite 900
Seattle WA 98101
206-553-1571

From: Douglas, Mark
Sent: Wednesday, June 06, 2018 8:41 AM
To: Mendelman, Krista <Mendelman.Krista@epa.gov>
Subject: Travel requests

Krista,

It got a little busy here late yesterday, I put in an additional travel request but am headed out the door now, can I possibly add another trip request during our lunch break?

https://www.adn.com/alaska-news/anchorage/2018/06/05/anchorage-federal-building-evacuated-for-hazardous-materials-response-official-says/

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 5/9/2018 11:19:46 PM
To: Thiesing, Mary [Thiesing.Mary@epa.gov]
Subject: RE: Fact sheets on AKLNG and ASAP
Attachments: ASAP Fact Sheet May 2018.docx

Second one coming in a minute.

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

From: Thiesing, Mary
Sent: Wednesday, May 09, 2018 2:53 PM
To: Douglas, Mark <douglas.mark@epa.gov>
Subject: Fact sheets on AKLNG and ASAP

Hi Mark,

Linda A-C would like fact sheets on these two projects. Can you update what you have and forward? I am putting together a briefing paper on the AK mitigation stuff and Pebble; Matt and Mark are preparing one on Donlin for their briefing tomorrow. I am sorry to have to ask this—I know how busy you are, but I don't have the same familiarity with the details as you do.

Thanks,

Mary Anne Thiesing
Regional Wetland Ecologist
(206) 553-6114
(206) 375-4772 (cell)
thiesing.mary@epa.gov

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 4/5/2018 5:57:08 PM
To: Linn, Jennifer [Linn.Jennifer@epa.gov]
Subject: Got your VM

Thanks for the reply! I'll pass along your thoughts for this effort to the 404 folks. In working with the AK District a large part of staff time is spent on the NEPA and EIS process for projects likek ASAP, AKLNG, Nanushuk, Donlin, and Pebble which can be challenging to capture fully in the 404 process.

I'm looking forward to helping with this effort in any way.

Thanks again,

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

Appointment

From: Douglas, Mark [/o=ExchangeLabs/ou=Exchange Administrative Group (FYDIBOHF23SPDLT)/cn=Recipients/cn=23501ccdede34f148129c582fa1860b4-Mdougl02]
Sent: 9/27/2018 8:10:14 PM
To: Peterson, Erik [Peterson.Erik@epa.gov]

Subject: Declined: Bristol Bay Check-in
Location: R10Sea-Room-14Elwha/R10-Rooms-Service-Center

Start: 10/23/2018 4:00:00 PM
End: 10/23/2018 5:00:00 PM
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Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 8/22/2018 6:39:15 PM
To: Vaughan, Molly [Vaughan.Molly@epa.gov]
Subject: RE: link to March 20 Pebble Technical note on Sharepoint

Thanks!

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

From: Vaughan, Molly
Sent: Wednesday, August 22, 2018 10:39 AM
To: Douglas, Mark <douglas.mark@epa.gov>
Subject: link to March 20 Pebble Technical note on Sharepoint

For ease of locating this document:

Internal Website/ Ex. 6

Molly Vaughan
U.S. Environmental Protection Agency Region 10
Alaska Operations Office
222 W. 7th Avenue #19
Anchorage, AK 99513-7588

907-271-1215
vaughan.molly@epa.gov

Message

From: Douglas, Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=23501CCDEDE34F148129C582FA1860B4-MDOUGL02]
Sent: 7/25/2018 6:25:51 PM
To: Personal Email / Ex. 6
Attachments: Sec4.22_Wetlands_FINAL.docx

Mark Douglas
Aquatic Resources Unit
Office of Environmental Review & Assessment

U.S. Environmental Protection Agency
Alaska Operations Office
222 W. 7th Avenue, Box 19
Anchorage, AK 99513-7588
Phone (907) 271-1217

Note to Reviewers

This section is an early stage preliminary draft, and has been prepared prior to the completion of scoping for the purpose of setting analytical direction and facilitating the project schedule for completing the EIS.

As an initial draft, it is incomplete in many ways, and contains numerous placeholders to be addressed as more information becomes available. The Scoping Comment Period has not closed, Alternatives to the Proposed Action have not been formally identified, information needed to complete the analysis is not yet fully available and in the process of being requested from the applicant, and the approach for topics such as spills/dam failures, traditional knowledge and cumulative effects has not been settled. In addition, supporting analysis and logic for determination of potential environmental consequences have not been fully developed. This draft is intended to frame the eventual section, and in doing so, allow USACE to see the intended topics and content for the eventual completed sections. Notes are included in many sections to identify where the analysis is incomplete.

4.22 WETLANDS/SPECIAL AQUATIC SITES

The project has the potential to result in the following direct and indirect effects to wetlands/special aquatic sites and waterbodies (henceforth, referred to as "wetlands"):

- Direct impacts from removal of wetland vegetation and soil
- Indirect impacts from:
  - Disruption of wetland hydrology
  - Alteration of surface water quantity or distribution
  - Alteration of subsurface water quantity and distribution
  - Erosion and sedimentation.

Project impacts have been assessed by watershed to place the impacts in an ecological context. U.S. Geological Survey (USGS) Hydrologic Unit Code Tenth Level (HUC10) watersheds have been used for this purpose, and define the environmental impact statement (EIS) analysis area for wetlands. Impact assessments were considered, analyzed, and determined from the perspective of overall regional Alaskan vegetation affected. To contextualize project impacts, the analysis for vegetation applied publicly available environmental data for the EIS analysis area for the nine HUC10 watersheds that could potentially be directly or indirectly affected.

The magnitude of impacts to wetlands were assessed in terms of percent of disturbance area to high-value wetlands or greater proportions of low-value wetlands in the EIS analysis area. Magnitude would be less for disturbance areas below five percent, and would be greater for disturbance areas above five percent, with greatest intensity for disturbance areas above 25 percent. Some areas of wetlands would be reclaimed, and some would not. The duration of impacts would be temporary, meaning wetland functions would be reduced during the construction phase; or permanent, meaning reduction or elimination of wetlands functions would occur after the construction phase, through the operations and into the closure and post-closure phase. The extent of impacts would be limited to areas of the project area in which wetlands would be removed or disturbed, or would affect wetlands outside of the project area, within one or more HUC 10 watersheds.

To assess the relative magnitude and extent of impacts, the relative proportion of common wetland types in each watershed was estimated. The National Wetland Inventory (NWI) mapping covers only about one-fourth of the watershed area, and was therefore not sufficient for this effort. The uniform vegetation mapping provided by the Alaska Center for Conservation Science (ACCS) provided the best available spatial data for estimating wetland coverage for the HUC10 watersheds.

Vegetation class descriptions from the Vegetation Map and Classification guidebooks (Boggs et al. 2016a, 2016b) were reviewed. Vegetation classes mapped in the watersheds were assigned to one of the following types in a crosswalk for comparison with wetlands mapped for the project: upland, forested wetland, shrub wetland, herbaceous wetland, aquatic bed wetland, or waterbody.

The descriptions of herbaceous vegetation classes included wetland status; therefore, these vegetation classes were directly crosswalked to herbaceous wetland or upland. The woody vegetation classes lacked wetland status, so it was not possible to directly crosswalk types. Because forested vegetation types were uncommon, an assignment was made for each mapped unit based on site characteristics.

Shrub vegetation classes were common; a shrub vegetation class was assigned to wetland or upland based on a review of site characteristics. The dwarf shrub class in particular was not broken out in the mapping to differentiate dry sites from wet sites. Therefore, the acreages and percentages for each watershed are used here for comparison purposes, and should be considered an approximation of the actual extent of wetlands.

4.22.1 No Action Alternative

Under the No Action Alternative the Pebble Project would not be constructed, and no new impacts to wetlands would occur.

4.22.2 Action Alternative 1 – Applicant's Proposed Alternative

4.22.2.1 Mine Site Direct Impacts

[Note: Section to be revised with updated numbers and descriptions based on updated project description.]

[Note: Temporary versus permanent impacts will be refined in all text and tables pending an updated project description].

Most project-related direct impacts to wetlands would be initiated during the construction phase and would result in temporary or permanent loss of wetlands or alteration in wetland functions. Primary direct construction-related impacts to wetlands and waterbodies would include:

- Clearing and removal of wetland vegetation
- Placement of fill in wetlands and waterbodies
- Excavation that eliminates wetlands and waterbodies
- Compaction, rutting, and mixing of wetland soils.

Excavation of the open pit, quarries, and sediment ponds and filling within the tailings storage facility (TSF) and stockpiles would occur throughout the active life of the mine. The maximum extents of all surface disturbance impacts were used to evaluate direct wetlands impacts for the Mine Site. Some wetland reclamation would begin shortly after the start of construction and would continue throughout operations and closure.

A total of 3,191 acres of wetlands and waterbodies would be directly affected by the proposed Mine Site facilities (Table 4.22-1). The greatest impacts would occur from the bulk tailings storage cell (1,083 acres), the TSF (548 acres), the open pit (178 acres), and the haul road (162 acres).

Within the Mine Site, most impacts to wetlands (XX acres) would occur within one of the HUC10 watersheds, named the "Headwaters Koktuli River watershed" (Figure 4.22-1; Table 4.22-1). Less than 10 of impacts to wetlands and waters would occur within the Upper Talarik Creek Watershed (Table 4.22-1). Direct impacts in these watersheds would affect primarily deciduous shrub wetlands on slopes (XX percent and XX percent, respectively) and herbaceous wetlands on slopes (XX percent and XX percent, respectively). Previous disturbance to wetlands in this area is minimal. Facilities have been sited to avoid and minimize wetland impacts and allow efficient reclamation of disturbed areas.

[Note: The above sections will be updated with an updated project footprint.]

Excavation, filling, and clearing of wetlands would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions. Construction-related disturbances may alter wetland modification of groundwater functions (recharge and discharge), and would decrease stormwater and floodwater storage and modification of streamflow functions by decreasing the wetlands' potential to dissipate energy and reduce peak flows. These altered hydrologic functions would extend to the streams connected to or downstream from the affected wetlands. See Section 4.16, Surface Water Hydrology, for a discussion of surface water hydrology impacts.

Construction on or through wetlands would decrease or remove the wetlands' potential to improve water quality by preventing erosion and settling sediments. Sediment barriers and erosion control planning would mitigate the loss of this wetland function. Vegetation clearing with no soil disturbance reduces the wetlands' ability to modify water quality and its contribution to the abundance and diversity of wetland fauna. It also may reduce the export of detritus and contribution to the abundance and diversity of wetland flora functions, depending on the extent of vegetation being cleared.

The Headwaters Koktuli River watershed is estimated to contain approximately 56,000 acres of wetlands and waterbodies (33 percent of the watershed). Approximately 45,000 acres (26 percent of the watershed), are shrub wetlands and 9,000 acres (five percent) are herbaceous wetlands. Forested wetlands (39 acres) and aquatic bed wetlands (132 acres) each cover less than one percent. Mine Site activities would affect 2,460 acres of shrub wetlands and 657 acres of herbaceous wetlands within the Headwaters Koktuli River watershed (Table 4.22-1). This represents approximately five percent and seven percent, respectively, of shrub and herbaceous wetlands in the watershed. No forested wetlands and one acre of aquatic bed wetlands would be affected.

[Note: Information on specifics of unique, rare, or high-value wetlands types will be added in a later version.]

Riverine wetlands are another potentially high-value wetland type because of their numerous functions, especially fish and wildlife habitat functions. A total of 176 acres of riverine HGM class wetlands in the Headwaters Koktuli River watershed would be affected by activities at the Mine Site. The extent of riverine wetlands in the watershed is not known. They account for approximately six percent of the Mine Site mapping area. The watershed contains the North Fork and South Fork Koktuli River and their numerous tributaries. It is expected that riverine wetlands would account for at least six percent of the watershed as a whole, or approximately 10,000 acres. Therefore, the area of impacts from Mine Site activities would represent approximately two percent of all riverine wetlands in the watershed. Less than one acre of riverine HGM class wetlands in the Upper Talarik Creek Watershed would be affected by activities at the Mine Site.

Figure 4.22-1: Mine Site Area Watersheds Wetlands Impacts
[Note: Figure under development]

[Note: Table to be updated with revised project description information.]

Table 4.22-1: Mine Site Wetlands Direct Impacts

NWI Group	HGM[1] Class (Acres/percent)							Impact Area (acres)	Impact Area (%)
	Slope	Riverine	Riverine Channel	Depression	Flats	Lacustrine Fringe	Lacustrine Waters		
Headwaters Koktuli River Watershed									
Deciduous Shrub Wetlands	**2,247 71%**	**131 4%**	0	7 <1%	74 2%	<1	0	2,460	76
Herbaceous Wetlands	**607 19%**	40 1%	<1	3 <1%	6 <1%	<1	0	657	20
Aquatic Bed Wetlands	1 <1%	0	0	0	0	0	0	1	<1
Ponds	11 <1%	4 <1%	0	16 <1%	0	0	0	31	1
Lakes	0	0	0	0	0	0	<1	<1	<1
Perennial Streams	0	0	29 1%	0	0	0	0	29	1
Intermittent Streams	0	0	3 <1%	0	0	0	0	3	<1
Wetland/Water Totals	2,867	176	32	26	80	1	<1	**3,182**	100
Area (%)	90	5	1	1	2	<1	<1		
Uplands	3,658								
Totals	6,840								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									
Upper Talarik Creek Watershed									
Deciduous Shrub Wetlands	**6 67%**	<1	0	0	<1	0	0	6	67
Herbaceous Wetlands	**3 33%**	<1	0	<1	0	0	0	3	33
Aquatic Bed Wetlands	0	0	0	0	0	0	0	0	0
Ponds	0	0	0	<1	0	0	0	<1	<1
Lakes	0	0	0	0	0	0	0	0	0
Perennial Streams	0	0	<1	0	0	0	0	<1	<1
Intermittent Streams	0	0	<1	0	0	0	0	<1	<1
Wetland/Water Totals	9	<1	<1	<1	<1	0	0	**9**	100
Area (%)	100	<1	<1	<1	<1	0	0		
Uplands	25								
Totals	34								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									

[1]HGM = hydrogeomorphic

Reclamation

Pebble Limited Partnership (PLP) has incorporated requirements for mine closure and long-term water management into the design of the project. During the permitting phase, a reclamation plan would be developed that would include reclamation of wetlands where feasible. The discussion below is based on generally accepted wetland reclamation practices for mine sites in Alaska. PLP has also provided some conceptual-level information on reclamation in its application and in subsequent responses to requests for information.

The Alaska Department of Natural Resources (ADNR) approves reclamation plans and associated financial assurances before construction. In its project description for the Department of the Army Application (December 2017), PLP has identified some of the design elements that would facilitate successful reclamation during and after the closure phase:

- Quarried and waste rock would be geochemically tested prior to being used in construction to avoid the potential for contaminated drainage during operations and post-closure.
- Topsoil and overburden would be salvaged during construction for use as growth medium during reclamation.
- TSF embankment slopes would be designed to provide long-term stability and facilitate the placement of growth medium.
- The overall project footprint would be minimized to facilitate physical closure and post-closure water management.

[Note: This section will be updated with information from RFI 024.]

Material sites constructed in valley bottoms or lowland sites are candidates to be reclaimed to create new ponds with emergent wetlands where sufficient water quality and hydrology are available. Final contouring around created ponds could focus on providing habitat at the water's edge and a complex interspersion between wetland and upland vegetation. Moderate to steeply sloping wetland or upland mosaics with wetland inclusions would be less feasible to restore to wetlands because of the marginal hydrology, and some fills may not be removed in these areas. Marginal wetland hydrology would be expected in areas where excavations and road cuts through colluvium and rock have reduced overland sheet flow.

Shrub wetland successional processes, generally initiated by natural disturbances such as wildland fires, gradually reestablish typical vegetation and eventually hydrologic characteristics. When construction disturbs wetlands, successional processes may be prolonged or may not occur. Construction disturbances differ from natural disturbances in that the organic mat and organic soil horizons are often removed completely, which removes seedbeds, and reduces surface and subsurface water storage capacity. The timing and extent of recovery likely depend on the intensity, extent, and duration of the disturbance. The time required for wetlands to return to pre-disturbance soil moisture and original vegetation cover has not been well documented in western Alaska.

Development of self-sustaining wetland plant communities on previously disturbed Alaska wetlands may occur within 10 to 30 years, but may be slowed in gravelly or sandy soils, and by years with failed seedling establishment or seed production. Revegetation success may be enhanced by conducting careful planning and management; minimizing disturbance; segregating and protecting materials to be used during reclamation; using the appropriate seed mixture and seeding rates; and monitoring for erosion and revegetation success.

Reclamation of wetland conditions may be complicated in areas where less permeable layers have been breached or removed. This would alter surface hydrology, causing previous wetland

EPA-0135-0005048

areas to drain. In these situations, restored wetlands are likely to differ in type and functional capacity from the original wetlands for decades to centuries.

Surface water resources available to wetlands would continue to be altered in distribution and abundance with an estimated return to within XX percent of predevelopment streamflows at the downstream end of the mine development (see Section 4.16, Surface Water Hydrology). These changes in surface water distribution and abundance could cause some wetlands to dry up while others would be inundated or become wetter.

The pit lake would continue to fill for a period of several decades post-closure. Once the water level reaches elevation 890 feet, water would be pumped from the pit. This elevation is at least 50 feet below the elevation at which groundwater flow would be directed outward from the open pit. As a result, a new equilibrium groundwater level would become established around the pit. Wetlands and streams above the pit lake level would potentially lose groundwater to the cone of depression created by the pit lake. This may result in long-term wetland and streamflow effects. Groundwater modeling would be used to assess potential wetland and stream dewatering, and to identify those wetlands and functions that are likely to be affected (see Section 4.17, Groundwater Hydrology, for details).

[Note: The above sections will be updated with an updated project footprint.]

4.22.2.2 Mine Site Indirect Impacts

[Note: Information on this topic to be added at a later time].

Fugitive Dust

[Note: Information on this topic to be added at a later time].

Dewatering

[Note: Information on this topic to be added at a later time].

4.22.2.3 Amakdedori Port Direct Impacts

[Note: This section to be updated with revised project description information.]

Construction of Amakdedori Port would directly affect less than one acre of intertidal waters and 109 acres of subtidal waters in the Amakdedori Creek-Frontal Kamishak Bay watershed and 271 acres of subtidal waters in the Cook Inlet watershed (Table 4.22-2). The port terminal and associated facilities would be sited and designed to avoid most wetlands. Previous disturbance to wetlands or waterbodies in this area is minimal.

The Amakdedori Port facilities would be removed during closure, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies. Disturbed areas would be recontoured, graded, ripped, and scarified. Topsoil and growth media would be placed as needed, and surfaces would be seeded for revegetation.

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Table 4.22-2: Amakdedori Port Wetlands Direct Impacts

NWI Group	Impact Area (acres)	Impact Area (%)
Amakdedori Creek–Frontal Kamishak Bay Watershed		
Marine Subtidal	109	99
Marine Intertidal	1	1
Wetland/Water Totals	110	100
Uplands	194	–
Total Area	305	–
Cook Inlet Watershed		
Marine Subtidal	271	100
Total Area	271	–

[Note: Table to be updated with revised project description information.]

4.22.2.4 Amakdedori Port Indirect Impacts

Fugitive Dust

[Note: Information on this topic to be added at a later time].

Dewatering

[Note: Information on this topic to be added at a later time].

4.22.2.5 Transportation Corridor and Natural Gas Pipeline Corridor Direct Impacts

[Note: This section to be updated with revised project description information. Temporary versus permanent impacts will be addressed at that time, and a table with direct temporary impacts for the Natural Gas Pipeline Corridor will be included.]

Locations West of Cook Inlet

Construction of the Transportation and Natural Gas Pipeline corridors from Amakdedori Port to the Mine Site would directly and permanently affect XX acres of wetlands (Table 4.22-3). The south access road between the port and the south ferry terminal at Iliamna Lake would affect XX acres. The mine access road from the north ferry terminal to the mine site would affect ## acres of wetlands and waterbodies. The remaining XX acres of impacts would be from the Iliamna and Kokhanok Airport spur roads, material sites, and ferry landings.

Impacts would be permanent because the road would remain to facilitate long-term post-closure water treatment and monitoring. Previous disturbance to wetlands in this area is minimal. The corridor has been sited to avoid and minimize wetland impacts and allow for efficient reclamation of disturbed areas.

A total of XX miles of streams would be directly affected by construction, including XX miles of perennial streams and XX miles of intermittent streams (Table 4.22-3). The larger streams with a width at ordinary high water (OHW) of 16 feet or greater would be bridged. Bridge locations are shown in Figure 4.22-2. Site-specific designs have been developed for bridges. Smaller stream crossings would use a series of standardized, conceptual culvert design categories based on stream width and fish presence. See Section 4.16, Surface Water Hydrology, for a discussion of surface water hydrology impacts.

Activities in the Transportation and Natural Gas Pipeline corridors would affect wetlands in five HUC10 watersheds. The highest number of acres impacted (XX acres) would occur in the Upper Talarik Creek watershed (Figure 4.22-2; Table 4.22-3). Direct impacts in this watershed would affect primarily deciduous shrub wetlands on slopes (XX percent) and flats (XX percent), and along streams (XX percent).

The Upper Talarik Creek watershed is estimated to contain approximately 34,000 acres of wetlands and waterbodies (39 percent of the watershed). Approximately 31,000 acres (35 percent of the watershed) are shrub wetlands, and 1,200 acres (one percent) are herbaceous wetlands. Forested wetlands (636 acres) and aquatic bed wetlands (eight acres) each cover less than 1 percent. Activities in the Transportation and Natural Gas Pipeline corridors and in a small portion of the Mine Site would affect XX acres of shrub wetlands and XX acres of herbaceous wetlands in the Upper Talarik Creek watershed, which is estimated to be less than one percent of shrub and herbaceous wetlands in the watershed. No forested or aquatic bed wetlands would be affected.

Based on vegetation and wetland mapping for the project, five acres of bog vegetation would be affected by activities in the Transportation and Natural Gas Pipeline corridors in the Upper Talarik Creek watershed. The extent of bog vegetation in the watershed is not known.

A total of XX acres of riverine wetlands would be affected by activities in the Transportation and Natural Gas Pipeline corridors in the Upper Talarik Creek watershed (Table 4.22-3). The extent of riverine wetlands in the watershed is not known. They account for approximately four percent of the Transportation and Natural Gas Pipeline corridor mapping areas. Riverine wetlands are estimated to account for approximately four percent of the watershed as a whole, or 3,500 acres. The corridor impacts, therefore, would represent less than two percent of all riverine wetlands in the watershed.

Wetland and waterbody impacts in the other four watersheds would be relatively low from a watershed perspective. The Iliamna Lake watershed, excluding the lake itself, has an estimated 180,000 acres of wetlands and waterbodies (33 percent of the watershed). The project would result in direct impacts on XX acres of slope wetlands and one acre of riverine wetlands (Table 4.22-3). The Newhalen River watershed has an estimated 35,000 acres of wetlands and waterbodies (29 percent of the watershed); one acre of slope wetlands would be directly affected. The Gibraltar Lake watershed has an estimated 34,000 acres of wetlands and waterbodies (41 percent of the watershed); nine acres of slope wetlands would be directly affected. The Amakdedori Creek–Frontal Kamishak Bay watershed has an estimated 77,000 acres of wetlands and waterbodies (44 percent of the watershed); 15 acres of slope wetlands and one acre of riverine channel would be directly affected (Table 4.22-3). The Transportation Corridor does enter the Paint River watershed for a very short distance, but no wetland or waterbody impacts are anticipated.

[Note: Table to be updated with revised project description information.]

Table 4.22-3: Transportation Corridor and Natural Gas Pipeline Corridor (West of Cook Inlet) Wetlands Direct Impacts

NWI Group	HGM Class (Acres/percent)							Impact Area (Acres)	Impact Area (%)
	Slope	Riverine	Riverine Channel	Depression	Flats	Lacustrine Fringe	Lacustrine Waters		
Upper Talarik Creek Watershed									
Deciduous Shrub Wetlands	**34** **64%**	**6** **11%**	–	–	**5** **9%**	–	–	46	87
Herbaceous Wetlands	**4** **8%**	1	–	–	2	–	–	6	11
Wetland/ Water Totals	38	7	–	–	7	–	–	**53**	100
Area (%)	72	13	<1	<1	13	0	0		
Uplands	324								
Totals	377								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									
Newhalen River Watershed									
Deciduous Shrub Wetlands	1	–	–	–	–	–	–	1	100
Wetland/Water Totals	1	<1	<1	<1	0	0	0	**1**	100
Area (%)	100	<1	<1	<1	0	0	0		
Uplands	50								
Totals	52								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									
Iliamna Lake Watershed									
Deciduous Shrub Wetlands	**9** **50%**	–	–	–	–	–	–	10	56
Evergreen Shrub Wetlands	1	–	–	–	–	–	–	1	6
Herbaceous Wetlands	**5** **28%**	1	–	–	–	–	–	6	33
Ponds	1	–	–	–	–	–	–	1	6
Wetland/Water Totals	17	1	<1	<1	0	0	0	**18**	100
Area (%)	94	6	<1	<1	0	0	0		
Uplands	326								
Totals	**344**								

Table 4.22-3: Transportation Corridor and Natural Gas Pipeline Corridor (West of Cook Inlet) Wetlands Direct Impacts

NWI Group	HGM Class (Acres/percent)							Impact Area (Acres)	Impact Area (%)
	Slope	Riverine	Riverine Channel	Depression	Flats	Lacustrine Fringe	Lacustrine Waters		
Gibraltar Lake Watershed									
Deciduous Shrub Wetlands	**3 33%**	–	–	–	–	–	–	3	33
Evergreen Shrub Wetlands	**2 22%**	–	–	–	–	–	–	2	22
Herbaceous Wetlands	**3 33%**	–	–	–	–	–	–	3	33
Ponds	1	–	–	–	–	–	–	1	11
Wetland/Waters Totals	9	0	<1	0	0	0	<1	**9**	100
Area (%)	100	0	<1	0	0	0	<1		
Uplands	132								
Totals	**142**								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									
Amakdedori Creek–Frontal Kamishak Bay Watershed									
Deciduous Shrub Wetlands	**6 38%**	–	–	–	–	–	–	6	38
Herbaceous Wetlands	**5 31%**	–	–	–	–	–	–	5	31
Ponds	**3 19%**	–	–	–	–	–	–	3	19
Streams	–	–	1	–	–	–	–	1	6
Wetland/Waters Totals	15	0	1	<1	0	0	<1	**16**	100
Area (%)	94	0	6	<1	0	0	<1		
Uplands	166								
Totals	182								
Perennial Streams (Miles)									
Intermittent Streams (Miles)									

Figure 4.22-2: Upper Talarik Creek Watershed Impacts
[Note: Figure under development]

Locations East of Cook Inlet

[Note: The following section to be updated with revised project description information.]

Activities in the Natural Gas Pipeline Corridor on the Kenai Peninsula would affect wetlands and waterbodies in the Stariski Creek–Frontal Cook Inlet watershed (Figure 4.22-3). Direct impacts on this watershed would affect primarily shrub wetlands.

The pipeline would cross approximately 94 miles of Cook Inlet, between Anchor Point and Amakdedori Port. Horizontal directional drilling would be used to install pipe segments from the compressor station out into waters that are deep enough to avoid navigation hazards. From this point, the pipe would be installed in a trench out to a water depth of 200 feet, and then laid on the sea floor. Direct temporary impacts on approximately 340 acres of marine subtidal waters and less than one acre of intertidal waters would occur (Table 4.22-4). The compressor station at Anchor Point would be located in an area that would avoid wetland impacts.

Reclamation

The road system would be retained as long as required for the transport of bulk supplies needed for long-term post-closure water treatment and monitoring. Once no longer needed, the road system would be reclaimed. Disturbed areas would be recontoured, graded, ripped, and scarified. Topsoil and growth media would be placed as needed, and surfaces would be seeded for revegetation. The Iliamna Lake ferry facilities would be removed during closure. Once it is no longer required to provide energy to the Mine Site, the natural gas pipeline would be pigged and cleaned before being abandoned in place. Surface facilities associated with the pipeline would be removed and reclaimed.

During closure and post-closure, wetlands would be reestablished wherever practicable. The geographic extent of direct and indirect effects would affect five HUC10 watersheds, but the majority of impacts (54 percent) would occur in the Upper Talarik Creek watershed, in the Bristol Bay basin. Most impacts throughout all watersheds would be on shrub (59 percent) and herbaceous (18 percent) wetlands on slopes, which are common throughout the region. There would be some impacts on riverine wetlands (eight acres) that are important for fish habitat, although this represents a relatively small portion of riverine wetlands across all watersheds.

[Note: Table to be updated with revised project description information.]

Table 4.22-4: Natural Gas Pipeline Corridor (East of Cook Inlet) Wetlands Direct Impacts

NWI Group	Impact Area (acres)	Impact Area (%)
Amakdedori Creek–Frontal Kamishak Bay Watershed		
Marine Subtidal	3	100
Cook Inlet Watershed		
Marine Subtidal	334	100
Stariski Creek–Frontal Cook Inlet Watershed		
Forested Wetlands	<1	20
Shrub Wetlands	1	20
Herbaceous Wetlands	<1	–
Perennial Streams	<1	–
Marine Subtidal	3	60

Marine Intertidal	<1	–
Wetland/Water Totals	5	100
Uplands	37	–
Total Area	380	–

Figure 4.22-3: Stariski Creek–Frontal Cook Inlet Watershed Impacts

[Note: Figure under development].

4.22.2.6 Transportation Corridor and Natural Gas Pipeline Corridor Indirect Impacts

Fugitive Dust

[Note: Information on this topic to be added at a later time].

Dewatering

[Note: Information on this topic to be added at a later time].

4.22.2.7 Cumulative Effects

[Note: This section will be updated at a later time.]

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Appointment

From: Darwin, Henry [darwin.henry@epa.gov]
Sent: 9/14/2018 12:20:32 PM
To: Darwin, Henry [darwin.henry@epa.gov]; Leopold, Matt (OGC) [Leopold.Matt@epa.gov]; Fotouhi, David [Fotouhi.David@epa.gov]; Forsgren, Lee [Forsgren.Lee@epa.gov]

Subject: Discussion: Pebble
Location: WJCn 3412

Start: 9/14/2018 1:30:00 PM
End: 9/14/2018 2:00:00 PM
Show Time As: Busy

Sct: Connie Eng, 202 564 3279.

Appointment

From: Forsgren, Lee [Forsgren.Lee@epa.gov]
Sent: 5/11/2018 12:31:29 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]; Kaiser, Russell [Kaiser.Russell@epa.gov]; Frazer, Brian [Frazer.Brian@epa.gov]; Goodin, John [Goodin.John@epa.gov]; Campbell, Ann [Campbell.Ann@epa.gov]; Drinkard, Andrea [Drinkard.Andrea@epa.gov]; Fontaine, Tim [Fontaine.Tim@epa.gov]
CC: Hough, Palmer [Hough.Palmer@epa.gov]

Subject: Alaska Issue for the SAC Hearing Prep C Conference Line/Code / Ex. 6
Attachments: SAC draft ASAP.DOCX; SAC draft Donlin.docx; SAC draft AK Mitigation Memo.docx; Bristol Bay-Pebble Mine 404c_5-11-18.docx
Location: 3219B WJCE

Start: 5/11/2018 5:00:00 PM
End: 5/11/2018 6:00:00 PM
Show Time As: Busy

Recurrence: (none)

FY 2019 CONGRESSIONAL HEARING
BRISTOL BAY PEBBLE MINE CWA SECTION 404(c) REVIEW

QUESTION: Why didn't EPA withdraw its 2014 CWA Section 404(c) Proposed Determination?

ANSWER:

- On January 26, 2018, EPA issued a decision that suspends the proceeding to withdraw the Proposed Determination (PD) and leaves that Determination in place pending consideration of any other information that is relevant to the protection of the world-class fisheries contained in the Bristol Bay watershed, in light of the CWA Section 404 permit application that Pebble Limited Partnership (Pebble) has now submitted to the Corps.
- EPA's January 2018 decision neither deters nor derails the Corps' review of Pebble's Section 404 permit application, which is currently ongoing. Pebble continues to enjoy the protection of due process and the right to proceed.
- In making the decision regarding whether to withdraw the 2014 PD at this time, the EPA considered its relevant statutory authority, applicable regulations, and the input it received as part of the tribal consultation, ANCSA Corporation consultation, and public comment periods regarding the Agency's reasons for its proposed withdrawal, as well as recent developments, including Pebble's submittal of a Section 404 permit application to the U.S. Army Corps of Engineers in December of 2017.
- The EPA received more than one million public comments regarding its proposal to withdraw the 2014 PD, the overwhelming majority of which expressed opposition to withdrawal.

BACKGROUND:

- Since 2001, Northern Dynasty Minerals and its subsidiary Pebble have been planning a large-scale open pit mine at the Pebble deposit in the Bristol Bay watershed. The Bristol Bay watershed in southwest Alaska supports the largest sockeye salmon fishery in the world. The fishery is valued at $1.5 billion annually, supports about 14,000 jobs and has served as a significant subsistence fishery for Alaska Natives for over 4000 years.
- EPA's July 2014 CWA 404(c) PD outlines potential restrictions to limit the extent of salmon-supporting streams and wetlands that could be destroyed or degraded from the discharge of dredged or fill material related to mining the Pebble deposit.
- Pebble Lawsuits: In 2014 Pebble filed three lawsuits against EPA relating to EPA's work in the Bristol Bay watershed. A preliminary injunction associated with one of these lawsuits halted EPA's 404(c) review in November 2014. On May 11, 2017, Pebble and EPA reached a settlement agreement resolving the remaining lawsuits.
- As part of the settlement agreement, EPA agreed to initiate a process to propose to withdraw its 2014 CWA 404(c) PD.
- In December 2017, Pebble submitted its CWA Section 404 permit application to the Army Corps proposing to develop a mine at the Pebble deposit and the Corps initiated its Section 404 permit review and NEPA review processes.
- On January 26, 2018, the EPA made a decision to suspend the withdrawal of its 2014 CWA 404(c) PD regarding a potential mine at the Pebble deposit.

Originator: Tim Fontaine, OW, 202-564-0318
Approver: Benita Best-Wong, OW, 202-566-1159 May 11, 2018

Non-Responsive – Material Unrelated to Bristol Bay/Pebble Mine

Non-Responsive – Material Unrelated to Bristol Bay/Pebble Mine

Message

From: Campbell, Ann [Campbell.Ann@epa.gov]
Sent: 11/7/2018 8:55:15 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
CC: Penman, Crystal [Penman.Crystal@epa.gov]
Subject: Meeting with Alaskan Native Group

Lee, recommend adding Karen Gude, our tribal coordinator, and John Goodin or Brian Frazer.

Subject: Meeting with Alaskan Native Group
Location: 1201 Constitution Ave NW, Washington DC 20004; Please call 202-564-5700 for escort; 2369B WJCE

Start: Wed 11/14/2018 9:30 AM
End: Wed 11/14/2018 10:15 AM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: Forsgren, Lee
Required Attendees: peterrobertson@pebblepartnership.com

Categories: Blue Category

Lee and Crystal,

I hope all is well. I'm writing today to request a meeting with you, Lee, for a group of Alaskan Native leaders that will be in Washington on November 13 and 14 to discuss issues related to the Pebble Mine. The group will include:

Brad Angasan Alaska Peninsula Corporation

Ventura Samaniego Kijik Corporation

Lisa Reimers Iliamna Development Corporation

Sue Anelon Iliamna Natives Limited

Chasity Anelon Pebble Employee/ Iliamna Resident

Rhiannon Nanalook Pebble Employee/ Iliamna Resident

Shannon Johnson South Central foundation Clinic & Lake and Peninsula School Board

This group will be meeting with the Alaska delegation, with other members and staff in Congress, and with representatives of the Administration (at EPA, Interior and elsewhere).

I'm hoping we can find some time for this group on one of those two days. Let me know if that might work, or if you need anything else from me.

Best wishes,

Peter

Peter D. Robertson

The Pebble Partnership

1330 Connecticut Avenue, NW

Washington, DC 20036

Message

From: Hladick, Christopher [hladick.christopher@epa.gov]
Sent: 11/6/2018 1:20:39 AM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: FW: message to Henry

Lee:

This is a draft I would send to Henry. Thought you might have some input, if so don't hesitate to add or modify.

Deliberative Process / Ex. 5

Chris Hladick
Regional Administrator
U.S. Environmental Protection Agency, Region 10
Office: (206) 553-1234
Cell: (206) 247-2946
Fax: (206) 553-1809

Message

From: Spraul, Greg [Spraul.Greg@epa.gov]
Sent: 6/14/2018 5:51:41 PM
To: Drummond, Laura [Drummond.Laura@epa.gov]; Klasen, Matthew [Klasen.Matthew@epa.gov]
CC: Best-Wong, Benita [Best-Wong.Benita@epa.gov]; Forsgren, Lee [Forsgren.Lee@epa.gov]; Borum, Denis [Borum.Denis@epa.gov]; Kaiser, Sven-Erik [Kaiser.Sven-Erik@epa.gov]; Skane, Elizabeth [Skane.Elizabeth@epa.gov]; Fontaine, Tim [Fontaine.Tim@epa.gov]; Woods, Terry [Woods.Terry@epa.gov]
Subject: RE: By noon Friday: Help respond to QFRs from April 26 Administrator HEC hearing (?s on 404(c), WIFIA, lead/LCR, PFAS)
Attachments: HAC CAL-028-032 404 Permit.docx

Matt – The attached includes minor changes requested by the Corps as part of the HAC QFR process OCFO is running. This version will be sent to OMB for final clearance.

You should probably have the HEC responses be consistent.

From: Drummond, Laura
Sent: Monday, June 11, 2018 10:06 AM
To: Klasen, Matthew <Klasen.Matthew@epa.gov>
Cc: Best-Wong, Benita <Best-Wong.Benita@epa.gov>; Forsgren, Lee <Forsgren.Lee@epa.gov>; Borum, Denis <Borum.Denis@epa.gov>; Kaiser, Sven-Erik <Kaiser.Sven-Erik@epa.gov>; Skane, Elizabeth <Skane.Elizabeth@epa.gov>; Spraul, Greg <Spraul.Greg@epa.gov>; Fontaine, Tim <Fontaine.Tim@epa.gov>; Woods, Terry <Woods.Terry@epa.gov>
Subject: RE: By noon Friday: Help respond to QFRs from April 26 Administrator HEC hearing (?s on 404(c), WIFIA, lead/LCR, PFAS)

Matt,

Sorry we are a little late on this. Our responses are attached. I do not believe that our office coordinated our responses with the Corps, but I will reach out to them to doublecheck. Let me know if you have any questions.

Laura Drummond
Program Analyst – PMF 2014
U.S. Environmental Protection Agency
Office of Water – Resource Management Staff
Phone – (202) 564-6561

From: Klasen, Matthew
Sent: Tuesday, June 05, 2018 3:13 PM
To: Campbell, Ann <Campbell.Ann@epa.gov>; Fontaine, Tim <Fontaine.Tim@epa.gov>; Spraul, Greg <Spraul.Greg@epa.gov>
Cc: Forsgren, Lee <Forsgren.Lee@epa.gov>; Best-Wong, Benita <Best-Wong.Benita@epa.gov>; Borum, Denis <Borum.Denis@epa.gov>; Kaiser, Sven-Erik <Kaiser.Sven-Erik@epa.gov>; Skane, Elizabeth <Skane.Elizabeth@epa.gov>
Subject: By noon Friday: Help respond to QFRs from April 26 Administrator HEC hearing (?s on 404(c), WIFIA, lead/LCR, PFAS)

Ann, Tim, and Greg,

First – I'm sending this to all three of you because I'm not sure if this best flows through the special assistant or budget channels, especially given the SAC hearing the same day. We'll defer to you on that.

Attached are Questions for the Record that recently came in from House Energy & Commerce after the Administrator's April 26 budget hearing. I've attached both the full set (for your context) and the OW-specific questions (which is probably the only attachment you need to forward to the offices – but defer to you on that). You can disregard any of the office assignments in the longer document that conflict with the shorter doc.

The attached subset has questions on **404(c), WIFIA, lead & LCR, and PFAS**. You'll see that Deliberative Process / Ex. 5

Deliberative Process / Ex. 5

Please send us proposed, cleared responses by noon Friday; our OCIR team is hoping to get all the responses compiled by the end of the week. Let us know if there's any way we can help.

Thanks,
Matt

Matt Klasen
U.S Environmental Protection Agency
Office of Congressional Affairs
WJC North 3443P
202-566-0780
Personal Phone / Ex. 6

Message

From: Campbell, Ann [Campbell.Ann@epa.gov]
Sent: 6/13/2018 7:33:31 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: RE: Pebble Talking Points

Thank you.

Ann Campbell
Chief of Staff (acting)
Office of Water

From: Forsgren, Lee
Sent: Wednesday, June 13, 2018 3:13 PM
To: Campbell, Ann <Campbell.Ann@epa.gov>
Subject: RE: Pebble Talking Points

Good job with this.

From: Campbell, Ann
Sent: Wednesday, June 13, 2018 2:06 PM
To: Ferguson, Lincoln <ferguson.lincoln@epa.gov>
Cc: Forsgren, Lee <Forsgren.Lee@epa.gov>
Subject: Pebble Talking Points

As requested.

Ann Campbell
Chief of Staff (acting)
Office of Water

Message

From: Campbell, Ann [Campbell.Ann@epa.gov]
Sent: 6/13/2018 6:17:52 PM
To: Hough, Palmer [Hough.Palmer@epa.gov]
CC: Goodin, John [Goodin.John@epa.gov]; Frazer, Brian [Frazer.Brian@epa.gov]; Kaiser, Russell [Kaiser.Russell@epa.gov]; Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: RE: Top level talking points on Pebble

Thanks Palmer. I got them to the Administrator's Office.

Ann Campbell
Chief of Staff (acting)
Office of Water

From: Hough, Palmer
Sent: Wednesday, June 13, 2018 1:54 PM
To: Campbell, Ann <Campbell.Ann@epa.gov>
Cc: Goodin, John <Goodin.John@epa.gov>; Frazer, Brian <Frazer.Brian@epa.gov>; Kaiser, Russell <Kaiser.Russell@epa.gov>; Forsgren, Lee <Forsgren.Lee@epa.gov>
Subject: FW: Top level talking points on Pebble

Ann – Lee asked me to forward these to you so you can get them to the Administrator

---

From: Hough, Palmer
Sent: Wednesday, June 13, 2018 1:35 PM
To: Forsgren, Lee <Forsgren.Lee@epa.gov>; Goodin, John <Goodin.John@epa.gov>; Frazer, Brian <Frazer.Brian@epa.gov>; Kaiser, Russell <Kaiser.Russell@epa.gov>
Cc: Hladick, Christopher <hladick.christopher@epa.gov>
Subject: RE: Top level talking points on Pebble

Lee

John has reviewed the attached talking points and asked me to forward them to you. Please let us know if you need anything else.

Thanks, Palmer

From: Forsgren, Lee
Sent: Wednesday, June 13, 2018 11:50 AM
To: Goodin, John <Goodin.John@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>; Frazer, Brian <Frazer.Brian@epa.gov>; Kaiser, Russell <Kaiser.Russell@epa.gov>
Cc: Hladick, Christopher <hladick.christopher@epa.gov>
Subject: Top level talking points on Pebble

John,
I need 4 or 5 high level talking points for the Administrator on Pebble by 2:00 pm. Generally that Pebble has submitted a permit, we are working with the COE on the scope of the EIS, we are waiting to see what the actual mine might look like as part of the EIS/404 permit process before moving ahead with additional comments and anything else you think relevant.

Lee

D. Lee Forsgren
Deputy Assistant Administrator
Office Of Water
Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Room 3219 WJCE
Washington, DC 20460
Phone: 202-564-5700
Forsgren.Lee@epa.gov

Message

From: Campbell, Ann [Campbell.Ann@epa.gov]
Sent: 6/13/2018 6:05:44 PM
To: Ferguson, Lincoln [ferguson.lincoln@epa.gov]
CC: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: Pebble Talking Points
Attachments: Pebble TPs_6-13-18.docx

As requested.

Ann Campbell
Chief of Staff (acting)
Office of Water

Date: June 13, 2018

Pebble Talking Points

- In December 2017, Pebble submitted its CWA Section 404 permit application to the Army Corps of Engineers proposing to develop a mine at the Pebble deposit.
- In January 2018, the Corps issued a public notice that provided Pebble's permit application to the public and stated that an Environmental Impact Statement (EIS) will be required as part of its permit review process consistent with National Environmental Policy Act (NEPA).
- At the invitation of the Corps, the EPA has agreed to be a cooperating agency in the Corps' EIS process and we are currently working with the Corps on the scoping phase of the EIS process.
- The Corps currently estimates that a draft EIS will be ready for public notice and comment by mid to late spring of 2019.
- On January 26, 2018, EPA issued its decision to suspend the proceeding to withdraw its 2014 CWA Section 404(c) Proposed Determination regarding the Pebble deposit and leave that Determination in place pending consideration of any other information that is relevant to the protection of the world-class fisheries contained in the Bristol Bay watershed, in light of the CWA Section 404 permit application that Pebble has now submitted to the Corps.
- EPA's January 2018 decision neither deters nor derails the Corps' review of Pebble's Section 404 permit application, which is currently ongoing. Pebble continues to enjoy the protection of due process and the right to proceed.

<u>Additional Background from R10</u>

- On May 25th, Quantum Minerals pulled out of the project. They had pledged $150 M in return for 50% equity.
- Tom Collier visited R10 last week to discuss the project. They are working on other investors. They are also looking at projects within the Bristol Bay Region to improve Public Relations, such as power projects, gas pipeline to villages, or a contribution to a fund that would act as insurance for fisherman during poor salmon returns.
- Bryce Edgmon, Speaker of the House for Alaska State Legislature, recently wrote a letter criticizing the Corps process in the Pebble Limited Partnership permitting process.

Message

From: Campbell, Ann [Campbell.Ann@epa.gov]
Sent: 6/13/2018 5:58:55 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: RE: Top level talking points on Pebble

Lee, this is background. I can include it in the paper as such but won't incorporate it in to the TPS section.

Ann Campbell
Chief of Staff (acting)
Office of Water

From: Forsgren, Lee
Sent: Wednesday, June 13, 2018 1:40 PM
To: Campbell, Ann <Campbell.Ann@epa.gov>
Subject: Fwd: Top level talking points on Pebble

Sent from my iPhone

Begin forwarded message:

> **From:** "Hladick, Christopher" <hladick.christopher@epa.gov>
> **Date:** June 13, 2018 at 1:37:25 PM EDT
> **To:** "Forsgren, Lee" <Forsgren.Lee@epa.gov>
> **Subject: Re: Top level talking points on Pebble**
>
> On May 25th Quantum Minerals pulled out of the project. They had pledged $150 M in return fro 50% equity.
>
> Tom Collier visited R10 last week to discuss project: they are working on other investors. They are looking at projects within the B.B. Region to improve Public Relations, such as power projects, gas pipeline to villages, or a contribution to a fund that would act as insurance for fisherman during poor salmon returns.
>
> Bryce Edgmon, Speaker of the House for Alaska State Legislature, recently wrote a letter criticizing Corps process in PLP permitting process.
>
> Sent from my iPhone
>
> On Jun 13, 2018, at 8:49 AM, Forsgren, Lee <Forsgren.Lee@epa.gov> wrote:
>
>> John,
>> I need 4 or 5 high level talking points for the Administrator on Pebble by 2:00 pm. Generally that Pebble has submitted a permit, we are working with the COE on the scope of the EIS, we are waiting to see what the actual mine might look like as part of the EIS/404 permit process before moving ahead with additional comments and anything else you think relevant.
>>
>> Lee

D. Lee Forsgren
Deputy Assistant Administrator
Office Of Water
Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Room 3219 WJCE
Washington, DC 20460
Phone: 202-564-5700
Forsgren.Lee@epa.gov

Message

From: Hough, Palmer [Hough.Palmer@epa.gov]
Sent: 6/13/2018 5:53:48 PM
To: Campbell, Ann [Campbell.Ann@epa.gov]
CC: Goodin, John [Goodin.John@epa.gov]; Frazer, Brian [Frazer.Brian@epa.gov]; Kaiser, Russell [Kaiser.Russell@epa.gov]; Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: FW: Top level talking points on Pebble
Attachments: Pebble TPs_6-13-18.docx

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From: Hough, Palmer
Sent: Wednesday, June 13, 2018 1:35 PM
To: Forsgren, Lee <Forsgren.Lee@epa.gov>; Goodin, John <Goodin.John@epa.gov>; Frazer, Brian <Frazer.Brian@epa.gov>; Kaiser, Russell <Kaiser.Russell@epa.gov>
Cc: Hladick, Christopher <hladick.christopher@epa.gov>
Subject: RE: Top level talking points on Pebble

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John has reviewed the attached talking points and asked me to forward them to you. Please let us know if you need anything else.

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From: Forsgren, Lee
Sent: Wednesday, June 13, 2018 11:50 AM
To: Goodin, John <Goodin.John@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>; Frazer, Brian <Frazer.Brian@epa.gov>; Kaiser, Russell <Kaiser.Russell@epa.gov>
Cc: Hladick, Christopher <hladick.christopher@epa.gov>
Subject: Top level talking points on Pebble

John,
I need 4 or 5 high level talking points for the Administrator on Pebble by 2:00 pm. Generally that Pebble has submitted a permit, we are working with the COE on the scope of the EIS, we are waiting to see what the actual mine might look like as part of the EIS/404 permit process before moving ahead with additional comments and anything else you think relevant.

Lee

D. Lee Forsgren
Deputy Assistant Administrator
Office Of Water
Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Room 3219 WJCE
Washington, DC 20460
Phone: 202-564-5700
Forsgren.Lee@epa.gov

Date: June 13, 2018

Pebble Talking Points

- In December 2017, Pebble submitted its CWA Section 404 permit application to the Army Corps of Engineers proposing to develop a mine at the Pebble deposit.
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- EPA's January 2018 decision neither deters nor derails the Corps' review of Pebble's Section 404 permit application, which is currently ongoing. Pebble continues to enjoy the protection of due process and the right to proceed.

Message

From: Goodin, John [Goodin.John@epa.gov]
Sent: 6/12/2018 5:40:23 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: RE: Region 10 draft EIS response
Attachments: Pebble Project Scoping 060518 draft HQ Review 12June2018.docx

Here you go. The document was only sent as a SharePoint link (below) which you are welcome to use. The attached Word version has some edits from others in the document at the moment (the pdf was from the first clean version of the review document).
Thanks
John

Open Pebble Project Scoping 060518 draft HQ Review.docx

From: Forsgren, Lee
Sent: Tuesday, June 12, 2018 1:20 PM
To: Goodin, John <Goodin.John@epa.gov>
Subject: RE: Region 10 draft EIS response

John,

Deliberative Process / Ex. 5

Lee

From: Goodin, John
Sent: Tuesday, June 12, 2018 12:43 PM
To: Forsgren, Lee <Forsgren.Lee@epa.gov>
Cc: Frazer, Brian <Frazer.Brian@epa.gov>; Kaiser, Russell <Kaiser.Russell@epa.gov>; Hough, Palmer <Hough.Palmer@epa.gov>; Campbell, Ann <Campbell.Ann@epa.gov>
Subject: Region 10 draft EIS response

Lee—as mentioned yesterday, attached is the latest version of the Region's draft EIS response letter due at the end of the month to the Corps.
Staff from the Region, ORC, OGC, OFA, and OWOW have provided input. The Region is planning to brief the RA soon. Let me know if you need anything else at this stage.
Thanks
John

Message

From: Goodin, John [Goodin.John@epa.gov]
Sent: 6/12/2018 4:43:20 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
CC: Frazer, Brian [Frazer.Brian@epa.gov]; Kaiser, Russell [Kaiser.Russell@epa.gov]; Hough, Palmer [Hough.Palmer@epa.gov]; Campbell, Ann [Campbell.Ann@epa.gov]
Subject: Region 10 draft EIS response
Attachments: Pebble Project Scoping 060518 draft HQ Review.pdf

Lee—as mentioned yesterday, attached is the latest version of the Region's draft EIS response letter due at the end of the month to the Corps.
Staff from the Region, ORC, OGC, OFA, and OWOW have provided input. The Region is planning to brief the RA soon. Let me know if you need anything else at this stage.
Thanks
John

Message

From: Gude, Karen [Gude.Karen@epa.gov]
Sent: 11/13/2018 7:05:46 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: RE: 11/14 Meeting with Alaskan Native Group

Great. Thank you, Lee.

Karen

From: Forsgren, Lee
Sent: Tuesday, November 13, 2018 1:56 PM
To: Gude, Karen <Gude.Karen@epa.gov>
Cc: Campbell, Ann <Campbell.Ann@epa.gov>; Lousberg, Macara <Lousberg.Macara@epa.gov>
Subject: RE: 11/14 Meeting with Alaskan Native Group

Karen,

Non-Responsive – This is just a dog and pony show on the Pebble Mine. I am just going to sit quietly and listen.

Lee

From: Gude, Karen
Sent: Tuesday, November 13, 2018 1:47 PM
To: Forsgren, Lee <Forsgren.Lee@epa.gov>
Cc: Campbell, Ann <Campbell.Ann@epa.gov>; Lousberg, Macara <Lousberg.Macara@epa.gov>
Subject: 11/14 Meeting with Alaskan Native Group

Lee,

I see that I was included on the invitation for tomorrow's meeting with the Alaskan Native Group. Unfortunately, the meeting conflicts **Non-Responsive – Material Unrelated to Bristol Bay/Pebble Mine** If there is anything that you might need from me in support of the meeting with the Alaskan Native Group and/or wish that I attend the meeting, please let me know.

Thank you,

Karen Gude
Tribal Program Coordinator
U.S. EPA/Office of Water
Phone: (202) 564-0831

Subject: Meeting with Alaskan Native Group

Location: 1201 Constitution Ave NW, Washington DC 20004; Please call 202-564-5700 for escort; 3233 WJCE

Start: Wed 11/14/2018 9:30 AM
End: Wed 11/14/2018 10:15 AM
Show Time As: Tentative

Recurrence: (none)

Meeting Status: Tentatively accepted

Organizer: Forsgren, Lee
Required Attendees: peterrobertson@pebblepartnership.com; Gude, Karen; Frazer, Brian; Goodin, John
Optional Attendees: Penman, Crystal

Lee and Crystal,

I hope all is well. I'm writing today to request a meeting with you, Lee, for a group of Alaskan Native leaders that will be in Washington on November 13 and 14 to discuss issues related to the Pebble Mine. The group will include:

Brad Angasan Alaska Peninsula Corporation

Ventura Samaniego Kijik Corporation

Lisa Reimers Iliamna Development Corporation

Sue Anelon Iliamna Natives Limited

Chasity Anelon Pebble Employee/ Iliamna Resident

Rhiannon Nanalook Pebble Employee/ Iliamna Resident

Shannon Johnson South Central foundation Clinic & Lake and Peninsula School Board

This group will be meeting with the Alaska delegation, with other members and staff in Congress, and with representatives of the Administration (at EPA, Interior and elsewhere).

I'm hoping we can find some time for this group on one of those two days.   Let me know if that might work, or if you need anything else from me.

Best wishes,

Peter

Peter D. Robertson

The Pebble Partnership

1330 Connecticut Avenue, NW

Washington, DC 20036

Message

From: Hladick, Christopher [hladick.christopher@epa.gov]
Sent: 11/9/2018 10:38:59 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: RE: Pebble

Am at my desk. My cell is at home

Chris Hladick
Regional Administrator
U.S. Environmental Protection Agency, Region 10
Office: (206) 553-1234
Cell: (206) 247-2946
Fax: (206) 553-1809

From: Forsgren, Lee
Sent: Friday, November 9, 2018 1:58 PM
To: Hladick, Christopher <hladick.christopher@epa.gov>
Subject: RE: Pebble

Only Ross and I are the only ones left here.

From: Hladick, Christopher
Sent: Friday, November 9, 2018 4:56 PM
To: Forsgren, Lee <Forsgren.Lee@epa.gov>
Subject: RE: Pebble

I am around. I might be the only one in the building here in R 10. HQ can't be much better. What is our problem?

Chris Hladick
Regional Administrator
U.S. Environmental Protection Agency, Region 10
Office: (206) 553-1234
Cell: (206) 247-2946
Fax: (206) 553-1809

From: Forsgren, Lee
Sent: Friday, November 9, 2018 12:54 PM
To: Hladick, Christopher <hladick.christopher@epa.gov>
Subject: RE: Pebble

Will call when I get out of my last meeting.

From: Hladick, Christopher
Sent: Friday, November 9, 2018 3:00 PM
To: Forsgren, Lee <Forsgren.Lee@epa.gov>
Subject: Pebble

Lee:

I know you are probably slammed but any comments or additions to my e-mail on Pebble?

Happy Friday

Chris Hladick
Regional Administrator
U.S. Environmental Protection Agency, Region 10
Office: (206) 553-1234
Cell: (206) 247-2946
Fax: (206) 553-1809

Message

From: Spraul, Greg [Spraul.Greg@epa.gov]
Sent: 10/10/2018 8:16:39 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: Re: Appropriators are asking about Pebble...

Sharon will drop by

On Oct 10, 2018, at 4:04 PM, Forsgren, Lee <Forsgren.Lee@epa.gov> wrote:

> Am in 3233. Come see me.
>
> Sent from my iPhone
>
> On Oct 10, 2018, at 3:43 PM, Spraul, Greg <Spraul.Greg@epa.gov> wrote:
>
>> They want to know who the EPA decision official is since Wheeler is recused – I was
>> **Deliberative Process / Ex. 5**
>>
>> They are expecting an announcement in Dec. on 404(c) **Deliberative Process / Ex. 5**
>> **Deliberative Process / Ex. 5**
>>
>> Does this work?
>>
>> Anything else I should say?

Message

From: Campbell, Ann [Campbell.Ann@epa.gov]
Sent: 5/17/2018 5:13:27 PM
To: Fontaine, Tim [Fontaine.Tim@epa.gov]; Best-Wong, Benita [Best-Wong.Benita@epa.gov]; Forsgren, Lee [Forsgren.Lee@epa.gov]
CC: Woods, Terry [Woods.Terry@epa.gov]; Spraul, Greg [Spraul.Greg@epa.gov]
Subject: RE: HAC QFRs - for Your Approval
Attachments: CAL-028-032- dlf comments.docx; CAL - 001-003_AC edits.docx; CAL -004_AC edits.docx; JOY -001_AC edits.docx; KAP -011-014_AC edits.docx; KAP -008-010_AC edits.docx

Attached please find edits to the QFRs. Lee and Benita have both approved.

Ann Campbell
Chief of Staff (acting)
Office of Water

From: Fontaine, Tim
Sent: Thursday, May 17, 2018 10:43 AM
To: Best-Wong, Benita <Best-Wong.Benita@epa.gov>; Campbell, Ann <Campbell.Ann@epa.gov>; Forsgren, Lee <Forsgren.Lee@epa.gov>
Cc: Woods, Terry <Woods.Terry@epa.gov>; Spraul, Greg <Spraul.Greg@epa.gov>
Subject: FW: HAC QFRs - for Your Approval

Benita, Ann and Lee,

We are getting some pressure from OCFO to submit our HAC QFRs. Please let us know if there is anything more we can do to support your review. Thanks

Tim Fontaine
EPA Office of Water
(202) 564-0318

From: Woods, Terry
Sent: Tuesday, May 15, 2018 12:24 PM
To: Best-Wong, Benita <Best-Wong.Benita@epa.gov>; Forsgren, Lee <Forsgren.Lee@epa.gov>; Campbell, Ann <Campbell.Ann@epa.gov>
Cc: Fontaine, Tim <Fontaine.Tim@epa.gov>; Spraul, Greg <Spraul.Greg@epa.gov>
Subject: HAC QFRs - for Your Approval

Hi Benita and Lee.....

Attached you will find the Office of Waters responses to the Questions for the Record [QFRs] from the House Appropriations Committee [HAC] hearing on April 26, 2018 for your approval.

I have placed a hard copy in your incoming box. Please let me know if you have any questions. Thank you!

¸.•´¯`•.¸><((((º> .•´¯`•.><((((º>.•´¯`•.><((((º>.•´¯`•.

Terry Woods
Office of Water
Resource Management Staff

202-564-0326

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Appointment

From: Microsoft Outlook [MicrosoftExchange329e71ec88ae4615bbc36ab6ce41109e@usepa.onmicrosoft.com]
Sent: 6/5/2018 4:39:12 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]

Subject: Meeting Forward Notification: Pebble Mine Meeting
Location: 1201 Constitution Ave NW, Washington DC 20004 WJCE 3233 Please call 202-564-5700 for escort

Start: 6/5/2018 5:00:00 PM
End: 6/5/2018 5:45:00 PM

Recurrence: (none)

Your meeting was forwarded

Fotouhi, David has forwarded your meeting request to additional recipients.

Meeting

Pebble Mine Meeting

Meeting Time

Tuesday, June 5, 2018 1:00 PM-1:45 PM.

Recipients

Schwab, Justin

All times listed are in the following time zone: (UTC-05:00) Eastern Time (US & Canada)

Sent by Microsoft Exchange Server

Appointment

From: Goodin, John [Goodin.John@epa.gov]
Sent: 6/5/2018 1:11:40 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]

Subject: Declined: Pebble Mine Meeting
Location: 1201 Constitution Ave NW, Washington DC 20004 WJCE 3233 Please call 202-564-5700 for escort

Start: 6/5/2018 5:00:00 PM
End: 6/5/2018 5:45:00 PM
Show Time As: Busy

Message

From: Giddings, Daniel [giddings.daniel@epa.gov]
Sent: 4/20/2018 3:14:23 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
CC: Spraul, Greg [Spraul.Greg@epa.gov]; Fontaine, Tim [Fontaine.Tim@epa.gov]; Woods, Terry [Woods.Terry@epa.gov]
Subject: RE: Administrator's Hearing Prep - Program Office Summary Sheets for Review
Attachments: 04-20-2018 - House Budget Hearing Program Cheat Sheets V5 OCIR_OWedit.docx

Lee,

Please find the Administrator's talking points for next week's hearings attached. The majority of the bullets were pulled

Deliberative Process / Ex. 5

I'd like to draw your attention to three edits that resulted from this process.

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Please do not hesitate to follow up with me, Tim, or Greg with any questions.

Best,

Danny Giddings
Resource Management Staff
Office of Water
U.S. Environmental Protection Agency
(202)-564-0320

Begin forwarded message:

> **From:** "Forsgren, Lee" <Forsgren.Lee@epa.gov>
> **Date:** April 19, 2018 at 4:56:37 PM EDT
> **To:** "Campbell, Ann" <Campbell.Ann@epa.gov>, "Fontaine, Tim" <Fontaine.Tim@epa.gov>, "Spraul, Greg" <Spraul.Greg@epa.gov>, "Best-Wong, Benita" <Best-Wong.Benita@epa.gov>
> **Subject: Fwd: Administrator's Hearing Prep - Program Office Summary Sheets for Review**
>
> FYI
>
> Sent from my iPhone
>
> Begin forwarded message:
>
>> **From:** "Ringel, Aaron" <ringel.aaron@epa.gov>
>> **Date:** April 19, 2018 at 4:52:19 PM EDT
>> **To:** "Gunasekara, Mandy" <Gunasekara.Mandy@epa.gov>, "Forsgren, Lee" <Forsgren.Lee@epa.gov>, "Traylor, Patrick" <traylor.patrick@epa.gov>, "Beck, Nancy"

<Beck.Nancy@epa.gov>, "Kelly, Albert" <kelly.albert@epa.gov>, "Cook, Steven" <cook.steven@epa.gov>, "Yamada, Richard (Yujiro)" <yamada.richard@epa.gov>, "Bolen, Brittany" <bolen.brittany@epa.gov>, "Burke, Marcella" <burke.marcella@epa.gov>
Cc: "Greaves, Holly" <greaves.holly@epa.gov>, "Lyons, Troy" <lyons.troy@epa.gov>, "Shimmin, Kaitlyn" <shimmin.kaitlyn@epa.gov>, "Rodrick, Christian" <rodrick.christian@epa.gov>, "Palich, Christian" <palich.christian@epa.gov>, "Frye, Tony (Robert)" <frye.robert@epa.gov>, "Falvo, Nicholas" <falvo.nicholas@epa.gov>, "Hanson, Paige (Catherine)" <hanson.catherine@epa.gov>, "Feeley, Drew (Robert)" <Feeley.Drew@epa.gov>
Subject: Administrator's Hearing Prep - Program Office Summary Sheets for Review

Colleagues,

Attached is a program office summary document with topics we wanted to

Deliberative Process / Ex. 5

Please take a moment to review/make edits in your relevant areas. We are

Deliberative Process / Ex. 5

Deliberative Process / Ex. 5 Please feel free to reach out if you have any questions.

Best,
Aaron

Aaron E. Ringel
Deputy Associate Administrator
Office of Congressional & Intergovernmental Relations
U.S. Environmental Protection Agency

W: 202.564.4373
Ringel.Aaron@epa.gov

<04-19-2018 - House Budget Hearing Program Cheat Sheets V5 OCIR.docx>

PROGRAM OFFICE TOPICS SUMMARY

AIR AND RADIATION

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

CHEMICALS

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

WATER

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Bristol Bay-Pebble Mine CWA Sec. 404(c) Review

- EPA published its proposal to withdraw its CWA Section 404 (c) Proposed Determination (PD) in July 2017 and took public comment, held two public hearings in the Bristol Bay region, and consulted with tribal governments and Alaska Native Claims Settlement Act (ANCSA) Corporations from the Bristol Bay region.
- After reviewing all of the input and taking into consideration the recent developments regarding the submittal of Pebble Limited Partnership's (PLP) permit application, EPA has decided to suspend the withdrawal of the Proposed Determination at this time. This decision

neither deters nor derails the application process of PLP's proposed project and proponents continue to enjoy the protection of due process and the right to proceed.

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

OLEM/SUPERFUND

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

ORD

Non-Responsive: Unrelated to Bristol Bay/Pebble Mine

Message

From: Darwin, Henry [darwin.henry@epa.gov]
Sent: 9/13/2018 8:29:07 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]; Leopold, Matt (OGC) [Leopold.Matt@epa.gov]
Subject: FW: follow up

FYI – We can discuss when we meet.

Henry

From: Peter Robertson [mailto:peterrobertson@pebblepartnership.com]
Sent: Wednesday, September 12, 2018 3:15 PM
To: Darwin, Henry <darwin.henry@epa.gov>
Subject: follow up

Henry,

I wanted to thank you again for meeting with my CEO Tom Collier and me last month.

I've also just spoken with Steve Owens about your conversation, and am wondering whether you and I can follow up with a short phone call.

I'm happy to do it at nearly any time, including well after regular work hours if that best accommodates your busy daytime schedule. Let me know what might work best for you.

Thanks so much.

Sincerely,

Peter Robertson

Peter D. Robertson

The Pebble Partnership

1330 Connecticut Avenue, NW

Washington, DC 20036

202-629-3392

Message

From: Darwin, Henry [darwin.henry@epa.gov]
Sent: 7/31/2018 12:48:31 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: FW: Pebble Mine
Attachments: Pebble Mine

Lee, this is the meeting I mentioned to you last week. If you can make it, that would be great. If not, please let me know whom else I should ask. As we discussed as well, please let the appropriate entities opposed to the mine know that I am meeting with Pebble, and if they'd like a meeting I am open to one.

Thanks

Henry

Appointment

From: Darwin, Henry [darwin.henry@epa.gov]
Sent: 7/20/2018 8:18:16 PM
To: Darwin, Henry [darwin.henry@epa.gov]

Subject: Pebble Mine

Start: 8/2/2018 2:00:00 PM
End: 8/2/2018 3:00:00 PM
Show Time As: Busy

Message

From: Campbell, Ann [Campbell.Ann@epa.gov]
Sent: 7/26/2018 9:01:21 PM
To: Forsgren, Lee [Forsgren.Lee@epa.gov]
Subject: FOR YOUR REVIeW: Bristol Bay Presentation
Attachments: BB Presentation_AOO_20180727 (002).pptx; ATT00001.htm

Ann Campbell
Chief of Staff (acting)
Office of Water

Begin forwarded message:

> **From:** "Frazer, Brian" <Frazer.Brian@epa.gov>
> **Date:** July 26, 2018 at 4:18:47 PM EDT
> **To:** "Campbell, Ann" <Campbell.Ann@epa.gov>
> **Cc:** "Goodin, John" <Goodin.John@epa.gov>, "Huber, Patrick" <Huber.Patrick@epa.gov>
> **Subject: Bristol Bay Presentation**
>
> Ann – Here's the revised ppt presentation with the new title page.
>
> bf
>
> ******************************
> *Brian Frazer, Acting Director*
> *Oceans, Wetlands and Communities Division*
> *Office of Wetland, Oceans and Watersheds*
> *Office of Water*
> *USEPA*
> *1200 Pennsylvania Ave., NW*
> *Washington, DC 20460*
> *202-566-1652*

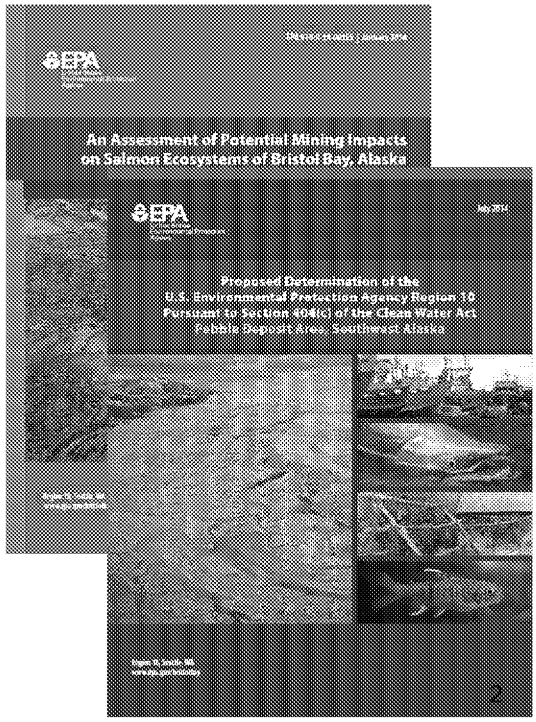
EPA's Work in the Bristol Bay Watershed

Presentation for EPA's Acting Assistant Administrator
Henry Darwin
July 27, 2018

Overview

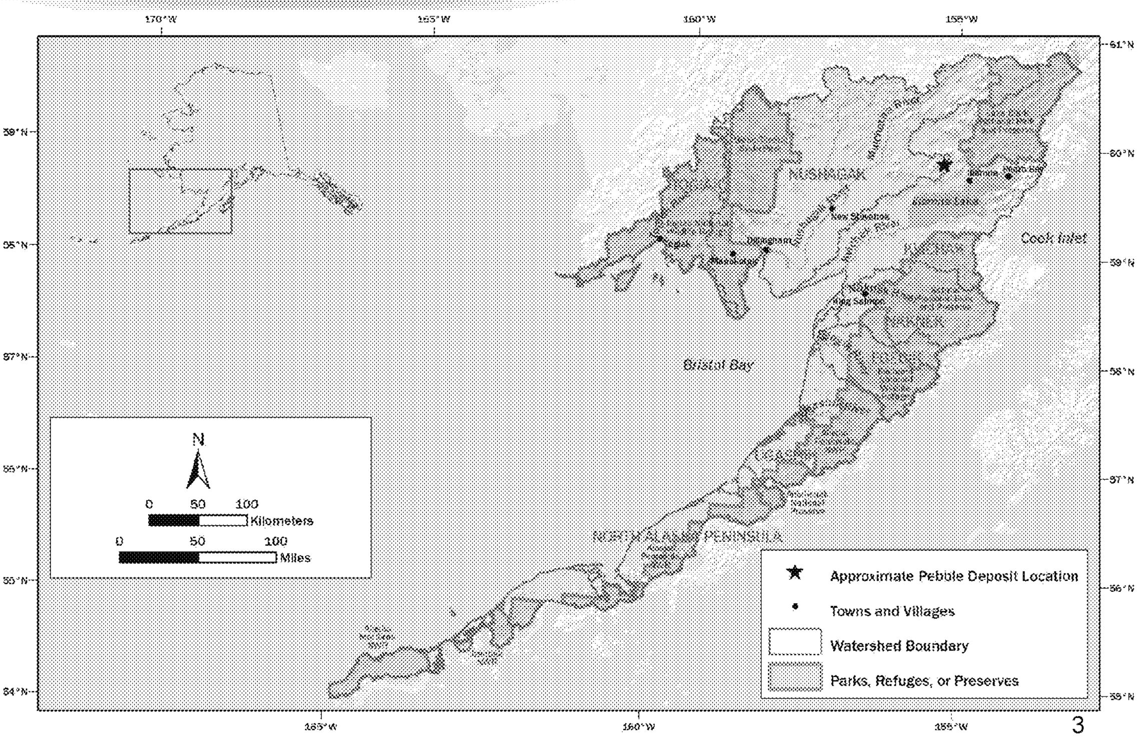
DRAFT

- EPA's Involvement History
- Science
- Section 404(c) Regulatory Response
- Section 404 Permitting and NEPA



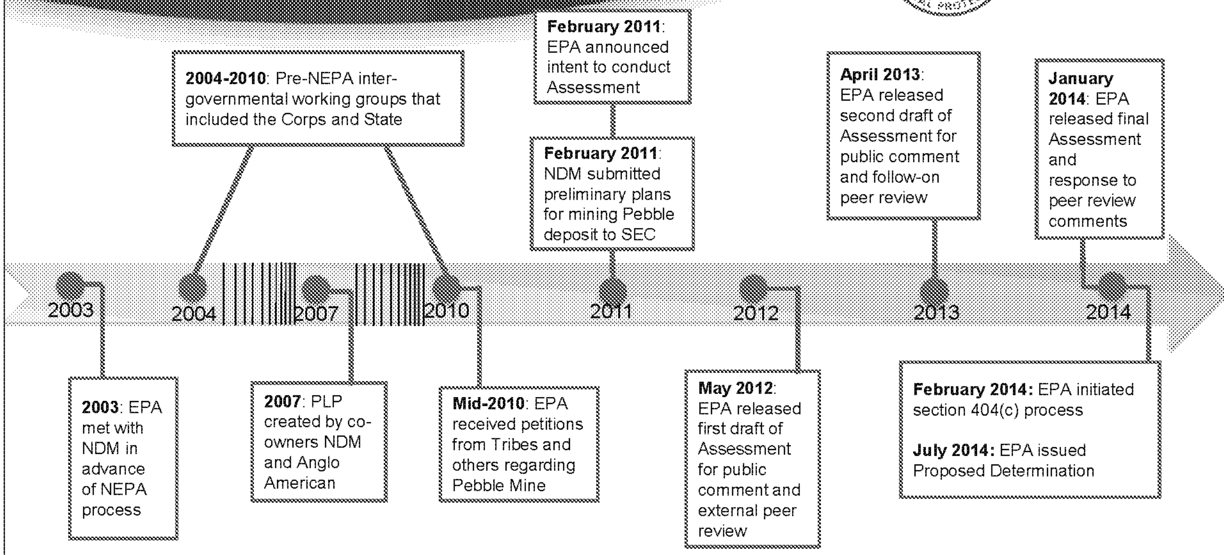
Bristol Bay Watershed

DRAFT



Timeline 2003 - 2014

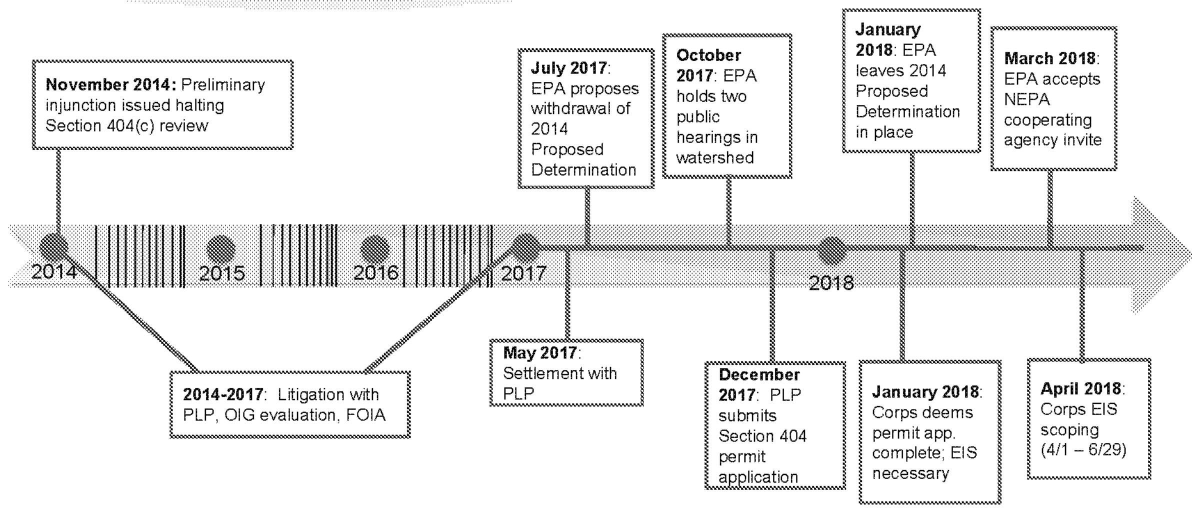
DRAFT



NDM = Northern Dynasty Minerals Ltd.
PLP = Pebble Limited Partnership
NEPA = National Environmental Policy Act
SEC = U.S. Securities and Exchange Commission

Timeline 2014 - Present

DRAFT

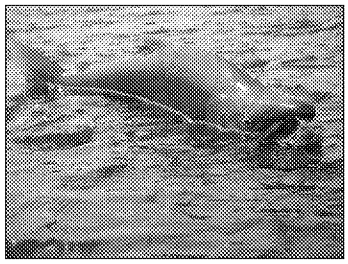


OIG = EPA Office of Inspector General
PLP = Pebble Limited Partnership
Corps = U.S. Army Corps of Engineers
EIS = Environmental Impact Statement

Bristol Bay Watershed Assessment

DRAFT

- Purpose:
  - Characterize the biological and mineral resources of the Bristol Bay watershed
  - Increase understanding of the potential impacts of large-scale mining on the region's fish resources
  - Inform future decision-making
- Scientific Ecological Risk Assessment evaluating potential impacts associated with:
  - Large-scale mine construction and operation
  - Accidents and failures



- Three-year scientific assessment effort
  - Independent external peer review
  - Stakeholder and public engagement
    - 8 public meetings
    - 2 rounds of public comment – over 1.1 million comments
  - Tribal consultations

Bristol Bay Watershed Resources

DRAFT

Biological Resources:

- Bristol Bay produces almost half of world's sockeye salmon
- Kvichak watershed world's largest producer of sockeye salmon
- Nushagak watershed frequently at or near world's largest producer of Chinook salmon

Biological Resources Support:

- 14,000 jobs, generates $480 million annually in direct economic expenditures and sales
  - Salmon fishery valued at $1.5 billion annually
- 4,000-year-old subsistence fishery for Alaska Natives

Geological Resources:

- At least 10 claims with more than minimal exploration, including Pebble.
- Pebble deposit: low-grade, with copper, gold, and molybdenum
- According to NDM, Pebble could:
  - Be largest mine of its type in North America
  - Produce 3,000 jobs in AK
  - Contribute $2.7 billion to US GDP annually
- Economics of mining the Pebble deposit are speculative
- Since 2001, five major mining companies have walked away from Pebble project

Bristol Bay Watershed Assessment

- Mining scenarios informed by NDM plans submitted to U.S. Securities and Exchange Commission (SEC) in 2011

- Uses 3 potential stages of mine development at Pebble deposit
  - 0.25-billion-ton mine (worldwide median size porphyry copper deposit)
  - 2.0-billion-ton mine (smallest mine size proposed by NDM to SEC)
  - 6.5-billion-ton mine (largest mine size proposed by NDM to SEC)

- NDM says deposit is nearly 12 billion tons

Bristol Bay Watershed Assessment

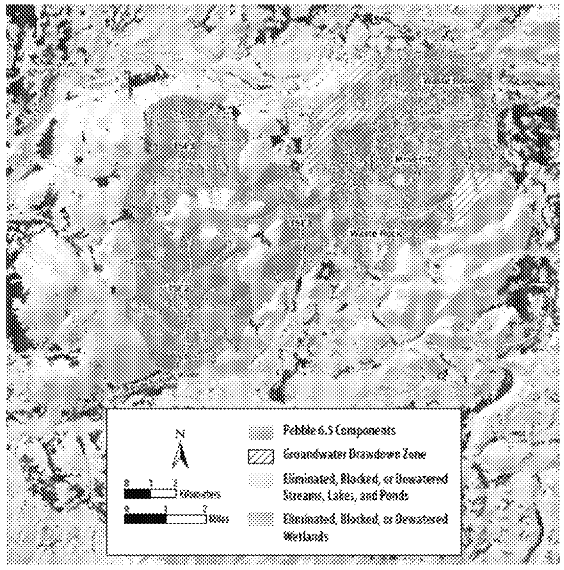
DRAFT

Mine Footprint Impacts:

- 24-94 miles of salmon-supporting streams destroyed
- 1,300-5,350 acres of wetlands, ponds, lakes destroyed
- 9-33 miles of salmon-supporting streams with altered streamflow likely to affect ecosystem structure and function

Other Impacts:

- Tailings dams need maintenance in perpetuity
- Routine operations and accidents would increase impacts on salmon habitat quality, both at the mining site and along the 86-mile transportation corridor.



Clean Water Act Section 404

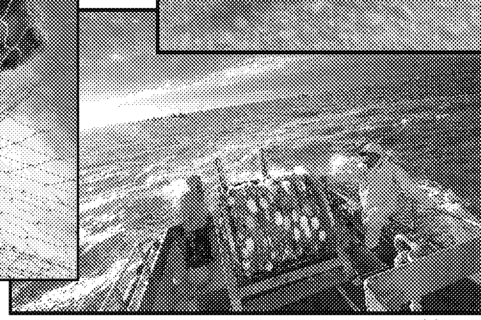
DRAFT

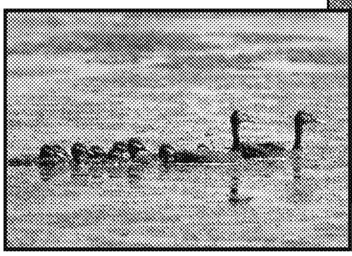
- § 404(a) authorizes the Secretary of the Army to issue **permits**
  - For the discharge of dredged or fill material into waters of the U.S. at specified disposal sites
- § 404(b) directs the Secretary of the Army to apply **environmental criteria** developed by EPA when specifying disposal sites
  - § 404(b)(1) Guidelines [40 CFR Part 230]
- § 404(c) authorizes EPA to prohibit, deny or restrict (withdraw) the placement of dredged or fill material at defined sites in waters of the U.S.

Limits of Section 404(c)

DRAFT

- **Whenever** it determines, after notice and opportunity for public hearing, that the discharge of such materials into such area will have an **unacceptable adverse effect(s)** on:
  - Municipal water supplies; or
  - Shellfish beds and **fishery areas**; or
  - Wildlife; or
  - Recreation areas.





Pebble Deposit 404(c) Process

DRAFT

Step 1

- 2/28/14: **Initiation by EPA Region 10 – "15-day letter"**
- Consulted with Corps, NDM/PLP, and State

Step 2

- 7/18/14: **Proposed Determination** released (PD) by EPA Region 10
- 8/12-15/14: 7 public hearings in Alaska
- > 670,000 written comments; > 99% (86% unique) supported Proposed Determination

Step 3

- EPA Region 10 will review the public comments
- EPA Region 10 will withdraw PD *or* prepare **Recommended Determination** (RD)

Step 4

- **Final Determination (FD) by EPA Assistant Administrator for Water**
- Consult again with Corps, NDM/PLP, and State
- Within 60 days of receipt of RD, issue FD affirming, modifying, or rescinding RD

What Are the Proposed Restrictions?

DRAFT

Restrict the discharge of dredged or fill material related to mining the Pebble deposit into waters of the U.S. that would, individually or collectively, result in the following:

1. **Loss of Streams.**
   a. The loss of 5 or more linear miles of streams with documented anadromous fish occurrence; **or**
   b. The loss of 19 or more linear miles of streams where anadromous fish are not currently documented, but that are tributaries of streams with documented anadromous fish occurrence; **or**

2. **Loss of Wetlands, Lakes, and Ponds.** The loss of 1,100 or more acres of wetlands, lakes, and ponds contiguous with either streams with documented anadromous fish occurrence or tributaries of those streams; **or**

3. **Streamflow Alterations.** Streamflow alterations greater than 20% of daily flow in 9 or more linear miles of streams with documented anadromous fish occurrence

Response to Section 404(c) Proceeding

DRAFT

- Office of Inspector General (OIG) Review
  - 17-month in-depth evaluation found no evidence of bias or a pre-determined outcome
  - Possible misuse of position for retired Region 10 employee noted
- PLP broad Freedom of Information Act (FOIA) requests
  - Approximately 18,000 documents produced
- PLP filed three lawsuits in 2014
  - Administrative Procedure Act (APA) challenge to initiation of 404(c) process
  - FOIA litigation
  - Federal Advisory Committee Act (FACA) litigation
- May 2017 settlement agreement
  - Resolved FOIA and FACA litigation and PLP's outstanding FOIA requests

Settlement Agreement

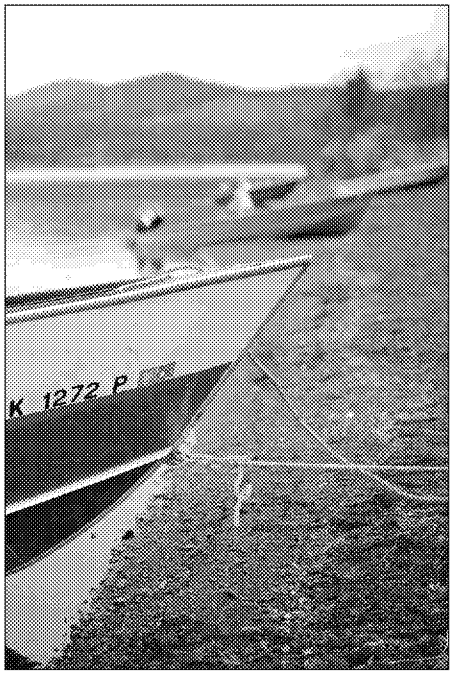
DRAFT

- Key terms of the May 11, 2017 settlement agreement between PLP and EPA:
  - EPA may use its Bristol Bay Watershed Assessment without limitation
  - EPA agrees to initiate a process to propose to withdraw its 2014 Proposed Determination by July 11, 2017
  - EPA agrees not to forward a Recommended Determination (the next step in the 404(c) review process) to EPA HQ until a Final EIS is noticed for the project or May 11, 2021, whichever is earlier
  - PLP drops remaining lawsuits and fee requests against EPA and agrees to file no new FOIA requests during the 2.5- to 4-year hiatus period

Proposal to Withdraw 2014 Proposed Determination

DRAFT

- July 2017: Withdrawal proposed based on policy rationale
  - EPA did not solicit comment on the proposed restrictions or on science or technical information underlying the Proposed Determination
- Outreach and Consultation
  - Proposal generated >1 million comments (~99% opposed)
  - 2 public hearings in watershed
  - Tribal and ANCSA Consultation
    - 16 tribal governments and 1 ANCSA Regional Corp. opposed
    - 1 tribal government and 2 ANCSA Village Corps. supported

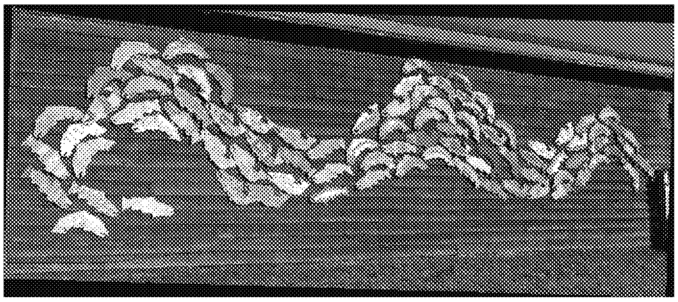


Section 404(c) Next Steps

DRAFT

- In January 2018 EPA decided not to withdraw and suspended Section 404(c) process pending further review

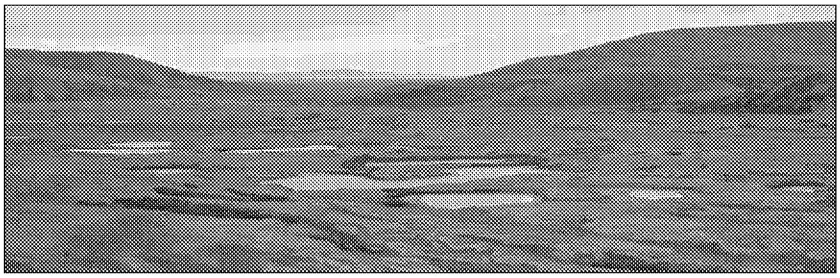
- Settlement agreement obligations
  - EPA can issue a new/modified Proposed Determination at any time
  - EPA Region 10 cannot forward a Recommended Determination to EPA HQ until May of 2021 or until a final EIS is noticed, whichever comes first



2017 Permit Application

DRAFT

- PLP filed Department of Army (DA) permit application to the Corps in December 2017
  - Includes CWA 404 and RHA Section 10
  - Includes Project Description: mine, power supply, transportation
- Corps deemed application sufficient to begin NEPA



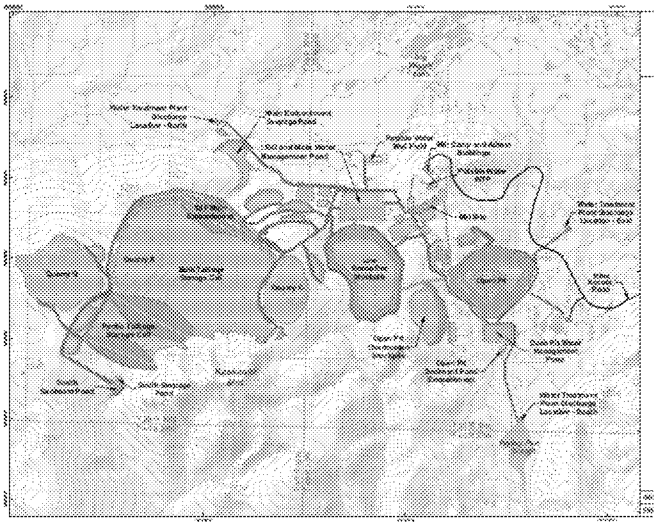
Pebble deposit area

DRAFT

Project Description

Mine Site

- 1.3 billion tons of ore mined over 20 years
- 160,000 tons/day of ore processed to produce:
  - Copper concentrate
  - Molybdenum concentrate
  - Gold via gravity separation
- Open pit mine, ore storage pile, 2 tailings impoundments
- 2 water treatment plants and 3 discharge outfalls
- Closure
  - PAG waste rock & pyritic tailings backfilled into open pit
  - Dry closure of bulk tailings
  - Long-term water treatment



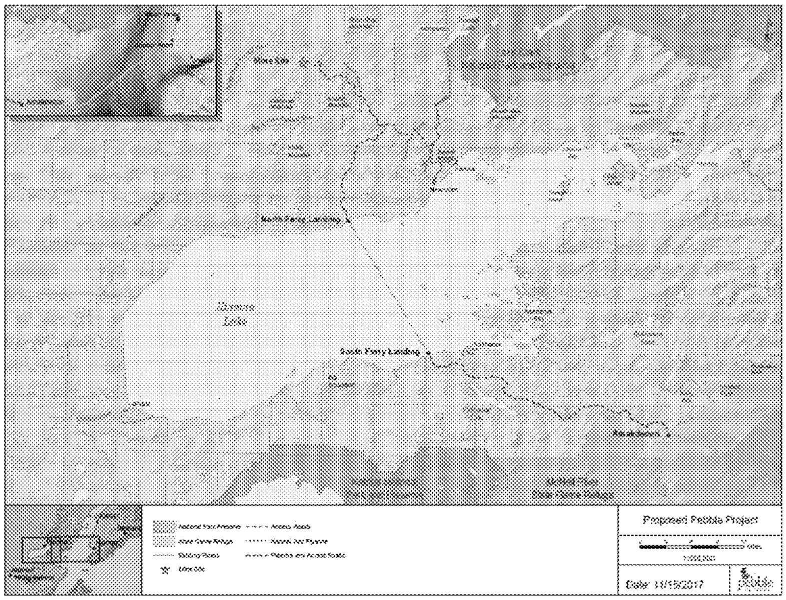
Project Description

Power

- 230 - 270 MW power plant at mine site
- 188 mile natural gas pipeline

Transportation

- 65 miles of roads
- Ferry across Lake Illiamna
- Cook Inlet port site



Project Description

DRAFT

- Proposed mine is:
  - Smaller than 2011 Preliminary Assessment to SEC
  - Larger than the EPA Assessment's 0.25 billion ton mine scenario, which is the basis for the 2014 Proposed Determination

2014 Proposed Determination
Loss of 5 or more miles of streams with anadromous fish; or
Loss of 19 or more miles of streams that are tributaries of anadromous fish streams; or
Loss of 1100 or more acres of wetlands, lakes and ponds contiguous with streams or tributaries to streams that have anadromous fish; or
Stream flow alteration > 20% of daily flow in 9 or more miles of streams with anadromous fish

2017 DA Application	
component	**wetlands filled**
Mine site	3190
Transportation (roads, ferry terminals, port)	480
Pipeline	408
TOTAL	4078

- Differences from 2011 Preliminary Assessment and EPA's Assessment:
  - Less waste rock mined
  - No cyanide leaching
  - Liners (pyritic tailings)
  - Advanced water treatment and "Physical Habitat Simulation System" to mitigate dewatering
  - Compensatory mitigation - TBD
- Project description could evolve during EIS and 404 review

Initial Corps NEPA & 404 Process

DRAFT

- Corps issued informational Public Notice of application (January 5, 2018)
  - Did not request public comment at this time
- Corps Cooperating Agency Plan specifies agency involvement.
  - EPA's cooperating agency involvement is limited to Section 404(b)(1) issues
- EIS scoping occurred April 1 through June 29
  - EPA submitted scoping letter
- Corps is developing preliminary EIS sections
  - EPA reviewing and providing comments where requested

Corps NEPA Schedule

DRAFT

- Corps EIS schedule:
  - Draft EIS – January 2019
  - Final EIS – late 2019
  - Record of Decision – early 2020
- PLP has requested inclusion of the project in FAST 41 infrastructure & critical minerals streamlining

Corps' Pebble website
https://pebbleprojecteis.com/

NEPA Cooperating Agencies

DRAFT

- Federal
  - DOT Pipeline and Hazardous Materials Safety Administration
  - US Coast Guard
  - DOI Bureau of Safety and Environmental Enforcement
  - US Fish and Wildlife Service
  - National Park Service
  - Advisory Council on Historic Preservation
  - EPA
- State
  - Alaska Department of Natural Resources Office of Project Management and Permitting coordinates state agencies (ADNR, ADEC, ADFG, SHPO)
- Local Governments
  - Lake & Peninsula Borough & Kenai Peninsula Borough
- Tribes
  - Curyung Tribal Council
  - Nondalton Tribal Council

EPA Response to Permit Application

DRAFT

- EPA Role
  - NEPA
    - Cooperating agency
    - CAA 309 review of the Draft EIS
  - Clean Water Act
    - CWA 404 permit application & 404(b)(1) review
    - Oversight of State CWA 402 Alaska Pollutant Discharge Elimination System Permit
  - Clean Air Act
    - Oversight of State Air Quality Permit
- EPA has developed a cross-programmatic, multi-disciplinary team